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CONTENTS.

ORIGINAL ARTICLES.

(741) Wt.P2/154. 1,000. 7.21. B.&F.Ltd. G14/14.

MISCELLANEOUS.

PLATES.

MAPS.

ERRATA.

Page 159, line	16	for	(iii, pp. 93–102)	read	(viii, pp. 93–102)
,, 212,	,, 25	,,	writer	,,	winter
,, 237,	,, 36	,,	*D.*	,,	*Dr.*
,, 254,	,, 10	,,	Rev. App. Ent. i	,,	Rev. App. Ent., B, i
,, 380,	,, 24	,,	(Pl. , fig. 46)	,,	(Pl. XVII, fig. 1)

IMPERIAL BUREAU OF ENTOMOLOGY.

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THE COCCIDAE OF SOUTH AFRICA—V.*

By CHAS. K. BRAIN, D.Sc.

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(PLATES I–IV.)

CONTENTS.

Subfamily LECANIINAE.

This subfamily comprises a large number of genera, which are, as a rule, easily distinguished by the presence or absence of secretionary matter in one form or another. All agree, however, in having the anal ring with a number of hairs and, further, in having the hind margin cleft. The anal ring is covered above by a pair of more or less triangular plates which are usually densely chitinised. The eighteen genera known to be represented in South Africa are tabulated below :—

*For Part II, see Bull. Ent. Res. ix, p. 107; Part III, *op. cit.* ix, p. 197; Part IV, *op. cit.* x, p. 95.

(681) Wt.P4/140. 1,000 7.20 B.&F.Ltd. Gp. 11.

Key to South African Genera.

A. Female naked, or only covered by a very thin, inconspicuous film of secretion.

B. Adult ♀ with well-developed legs and antennae.

C. Adult ♀ with posterior extremity cleft.

(1) Female flat or slightly convex, derm not very hard when mature, without polygonal areas containing pits .. .. *Lecanium*, Burm., p. 3.

(2) Female becoming hard and convex at maturity, derm with ± oval or polygonal areas containing pits .. *Saissetia*, Deplan., p. 9.

CC. Adult ♀ with posterior extremity not cleft; female with four large groups of spinnerets .. .. *Hemilecanium*, Newst., p. 14.

BB. Adult ♀ without legs or antennae .. .. .. *Aclerda*, Sign., p. 15.

AA. Female secreting a greater or less amount of cottony or powdery matter.

B. Female naked above, secretion beneath or behind the insect.

C. Female with only a narrow fringe of secretion.

(1) Female very convex, dark red, abdominal segmentation very distinct *Allopulvinaria*, gen. nov., p. 16.

(2) Female flat or slightly convex, segmentation not pronounced, *Protopulvinaria*, Ckll., p. 16.

CC. Female secreting a definite protruding ovisac *Pulvinaria*, Targ., p. 17.

BB. Female partly covered with secretion.

(1) Adult ♀ covered above, except for the median area, with a thick coat of wavy threads which project beyond the margin in all directions *Ceronema*, Mask., p. 22.

(2) Adult ♀ enclosed in a felted sac, except the cephalic extremity which is ± exposed .. ..*Lichtensia*, Sign., p. 22.

BBB. Adult ♀ entirely enclosed.

C. Sac fitting closely to body of adult ♀ at maturity and later serving as ovisac; insect leaf-infesting .. .. *Filippia*, Targ., p. 23.

CC. Sac felted, stout, conical, insect root-infesting *Conofilippia*, gen. nov., p. 25.

AAA. Female secretion waxy, glassy or horny.

B. Covering of ♀ consisting of wax, generally soft and thick; no marginal fringe nor marginal processes; female with a ± conspicuous caudal process visible on removing the wax .. .. *Ceroplastes*, Gray, p. 26.

BB. Covering of ♀ glassy, or at least brittle, thin.

(1) Scale divided into plates and striated with rows of air-cells; not causing galls .. .. *Inglisia*, Mask., p. 36.

(2) As in *Inglisia* but causing galls on roots of host-plant *Cryptinglisia*, Ckll., p. 38.

(3) Scale divided into two halves not striated with air-cells, but with grooves radiating from apex .. .. .. *Parafairmairea*, Ckll., p. 39.

(4) Scale not divided into plates nor two halves, but rough and beset with protuberances, legs and antennae well-developed, anal cleft normal *Ceroplastodes*, Ckll., p. 40.

(5) Scale not divided into plates nor two halves, ± smooth, legs and antennae rudimentary, anal cleft lateral .. ..*Idiosaissetia*, gen. nov., p. 40.

(6) Similar to *Pulvinaria* but ovisac consisting of horny membrane instead of cottony matter .. ..*Membranaria*, gen. nov., p. 41.

Genus **Lecanium,** Burm.

Adult ♀ never hemispherical nor highly convex, derm remaining comparatively soft, without polygonal areas; usually light in colour and oval; legs and antennae present, well-developed.

191. **Lecanium hesperidum,** Linn.

Coccus hesperidum, Linn., Syst. Nat. Ed. x. 1, p. 455, 1758.
Chermes hesperidum, Geoff., Hist. Abr. Ins. i, p. 505, 1762.
Calypticus hesperidum, Costa, Faun. Reg. Nap. Cocc., p. 8, 1835.
Calypticus laevis, Costa, Faun. Reg. Nap. Cocc., p. 8, 1835.
Calymnatus hesperidum, Costa, Nuov. Osserv., p. 22, 1835.
Coccus patelliformis, Curt., Gard. Chron., p. 517, 1843.
Chermes lauri, Bdv., Ent. Hort., p. 340, 1867.
Lecanium platycerii, Pack., Rep. Mass. Bd. Agr., p. 260, 1870.
Lecanium angustatum, Sign., Ann. Soc. Ent. Fr. (5) iii, p. 398, 1873.
Lecanium maculatum, Sign., Ann. Soc. Ent. Fr. (5) iii, p. 400, 1873.
Lecanium alienum, Dougl., Ent. Mon. Mag., xxiii, p. 77, 1886.
Lecanium depressum var. *simulans*, Dougl., Ent. Mon. Mag. xxiv, p. 28, 1887.
Lecanium minimum, Newst., Ent. Mon. Mag., xxvii, p. 141, 1892.
Lecanium assimile var. *amaryllidis*, Ckll., Tr. Am. Ent. Soc. xx, p. 53, 1893.
Lecanium terminaliae, Ckll., Jl. Inst. Jamaica, i, p. 254, 1893.
Lecanium nanum, Ckll., Psyche, vii, Suppl., i, p. 19, 1896.
Lecanium flaveolum, Ckll., Psyche, viii, pp. 52, 53, 1897.
Lecanium minimum var. *pinicola*, Mask., N.Z. Trans. xxix, p. 310, 1897.
Lecanium ventrale, Ehrh., Can. Ent. xxx, p. 245, 1898.
Lecanium (*Calymnatus*) *hesperidum pacificum*, Kuw., Jl. N.Y. Ent. Soc. x, p. 30, 1902.
Lecanium signiferum, Green, Cocc. of Ceylon, pt. iii, p. 197, 1904.

"Adult female bright yellow or greenish-yellow, minutely speckled with red-brown, the specks sometimes agglomerated into transverse bars, especially on the median abdominal region; in other parts tending to form dotted lines radiating from centre to margin. In older examples the ground-colour may be ochreous or pale fulvous; and the maculation may form a broad median fascia. Under surface of older examples with a deep purple-brown or red patch covering the median abdominal area, becoming concave and forming a shelter for the young larvae. Dried specimens straw-coloured and much wrinkled. Form oblong-oval, often very irregular in outline; narrowest in front; more or less concave above according to age. In some individuals, generally on those protected by some shelter, I have noticed a double median longitudinal series of raised glassy points; but they appear to be very brittle and easily lost." (Green).

Length, 2·5–5 mm.; breadth, 1·5–3 mm.

The antennae are 7-jointed, with the 3rd, 4th and 7th joints subequal. The range of measurements from South African material is as follows:—(1) 27–35, (2) 30–37, (3) 51–61, (4) 54–65, (5) 20–24, (6) 17–27, (7) 44–51μ.

The anal plates are about 155μ long.

The hairs on the antennal joints are exceptionally thin and are distributed, 2 on joint I, 2 on II, 2 on IV, 1 on V and VI, 8 or 9 on VII.

The marginal spines are short, widely spaced, simple, and nearly always have their tips recurved. There are three stigmatic spines, laterals short, median about $3\frac{1}{2}$ times as long as laterals. The stigmatic clefts are but slightly recessed, with a few simple glands.

Habitat: On citrus and a large variety of cultivated plants common throughout the Union.

Collection Nos.: 110 and 136.

192. **Lecanium africanum,** Newstead.

Lecanium viride var. *africanum*, Newst., Ent. Mon. Mag. (2) ix, p. 95, 1898.
Lecanium viride (Green), Newst., Bull. Ent. Res. i, p. 187, 1910.
Lecanium africanum, Newst., Bull. Ent. Res. vii, p. 357, 1917.

"Female adult. Colour of dried specimens often yellowish green; others are bright ochraceous, straw-coloured or pale reddish-brown; eyes black. Dorsum, especially in the younger forms, with a series of black markings, often forming a narrow loop-like pattern; these markings are however rarely present in very old examples. Form oblong oval, but the outline is often irregular; narrowed in front and moderately convex, but the margins broadly flattened, especially the cephalic portion. Antennae of eight segments, rarely of seven; formula of the former: 3 (2, 4, 5, 8) 1 (6, 7); there is a very long hair on the 2nd and 5th segments, and several shorter ones on the 8th, 6th and 7th, each with a distinctly stouter hair. Legs normal, though the anterior tarsi sometimes exhibit a faint dorsal constriction. Anal lobes attenuated distally, inner margin longest; apices with a few fine short hairs. Anal cleft slightly less than one-third the length of the body. Stigmatic cleft very slight, sometimes scarcely visible; spines three in number, rather small, the central one being about three times the length of the laterals. Marginal spines small, generally slightly curved and faintly fringed distally. There are three to four hairs of varying length near the attachment of each of the antennae, and usually four rather longer and stouter ones just in advance of the anal lobes. Derm cells oval and markedly distinct in stained preparations, but scarcely visible in unstained specimens." (Newstead).

Habitat: On citrus, Pietermaritzburg, Natal, and Nelspruit, Transvaal. On coffee, Natal coast (Fuller).

Collection No.: 106.

193. **Lecanium ehretiae,** sp. n.

Adult ♀ somewhat similar to *L. hesperidum* but rather less convex and much darker in colour, dark brown to blackish, 3·6 mm. long by 1·8 mm. broad, regularly oval. A single fringe of very short hairs is noticeable around the margin when examined with a hand lens and the surface of the body then appears mottled greyish brown in colour; the anal plates are bright brown. The dorsal surface is slightly shiny, with very indistinct and indefinite ridges and depressions.

The antennae are 7 or 8-jointed, most often 7. The following range is obtained from a series of eight measurements :—7-jointed : (1) 24–34, (2) 54–61, (3) 54–61, (4) 68–75, (5) 24–31, (6) 14–24, (7) 34–41μ ; 8-jointed : (1) 34, (2) 51, (3) 65, (4) 51, (5) 30, (6) 20, (7) 21, (8) 41μ.

Leg I : coxa 68, femur + trochanter 170, tibia 126, tarsus 75, claw 20μ. Tarsal digitules very slender, hardly perceptibly clubbed. Trochanter with an apical spine about 85μ long.

Scattered over the integument, particularly around the antennae and anal plates, are numerous hairs, the longest of which may reach 80μ in length.

The marginal spines are comparatively long (80μ), slender, slightly curved, not truncate. They average approximately 54μ apart. The stigmatic cleft has two short spurs and a median longer one (40μ). The anal plates are comparatively short (142μ) and broad (170μ across the outer angles). The anal ring has six long hairs. The derm is apparently clear, without glands.

Habitat : On *Ehretia hottentottica*, Burch. ; collected by the writer at Brooklyn, Pretoria, October 1914.

Collection No. : 117.

194. **Lecanium pumilum,** sp. n.

Adult ♀ small, about 2 mm. long, and 1·5 mm. broad, moderately convex, dark reddish brown in colour, distinctly red when younger.

Antennae 7- or 8-jointed, more often 8. The following represents the range obtained from measuring the antennae of five insects :—7-jointed : (1) 20–24, (2) 34–37, (3) 51–54, (4) 27, (5) 24, (6) 17–20, (7) 41–54μ ; 8-jointed : (1) 24–27, (2) 27–44, (3) 48–51, (4) 17–24, (5) 24–34, (6) 17–20, (7) 17–20, (8) 37–44μ.

Leg I : coxa 51, femur + trochanter 153, tibia 95, tarsus 61, claw 17μ.

The anal plate is about 150μ long. The anal ring is produced on a delicate fluted tube ; it bears 8 long bristles and several shorter ones. The margin has the usual series of simple spines about 41μ long. Stigmatic cleft with 3 straight, moderately stout spines ; laterals about 24μ long, median about 71μ. Immediately within the margin are numerous scattered small simple gland pores, many with short sharp spines.

Habitat : On the stem of a native shrub, covered by a carton shelter constructed by ants ; collected by C. P. v.d.Merwe at Robertson, C.P., May 1915.

Collection No. : 125.

195. **Lecanium elongatum,** Sign. (Plate i, fig. 233.)

Lecanium elongatum, Sign., Ann. Soc. Ent. Fr. (5) iii, p. 404, 1873.
Lecanium longulum, Dougl., Ent. Mon. Mag. xxiv, p. 97, 1887.
Lecanium chirimoliae, Mask., N. Z. Trans. xxii, p. 137, 1889.
Lecanium ficus, Mask., Ent. Mon. Mag. xxxiii, p. 243, 1897.
Lecanium frontale, Green, Cocc. Ceylon, pt. iii, p. 192, 1904.

" Female dingy pale yellowish-grey ; elongate, narrow, ends broadly rounded, side margins slightly curved out, not recurved ; surface smooth, transversely arched, longitudinally level, semi-cylindric, not carinate, a band of fairly dark

reticulation along the sides, whence, in some examples, faint dark lines radiate to the margin; the disc occupied with a long, pale, clear, oval spot; or in some mature specimens the scale (female) is unicolorous yellow-brown, the dorsal pale spot partly or wholly covered, and on the sides minute pale dots in place of reticulation. Underside all pale, a broad space all round the insect, a conspicuous blackish eye-spot above each antenna." (Douglas).

Antennae long, of 8 segments, range in μ as follows:—(1) 34–40, (2) 51–58, (3) 68–82, (4) 54–58, (5) 41–54, (6) 24–31, (7) 20–31, (8) 34–41.

Anal plates longer than in *hesperidum* (170μ), with the outer angles more rounded. Marginal spines a little longer than in *hesperidum* (34μ), widely spaced, averaging 70–85μ apart. Usually simple, but some with apex broadened and slightly branched and recurved. Integument, when fully chitinised, with scattered, small, oval, clear spaces. Stigmatic spines (3); laterals longer, straighter and more pointed than in *hesperidum*, median about four times the length of laterals, broad at the base and tapering to an acute point.

Habitat: On *Acacia melanoxylon*; collected by A. Kelly, Joubert Park, Johannesburg, May 1915.

Collection No.: 111.

196. **Lecanium pseudelongatum,** sp. n.

Adult ♀ similar to *elongatum* but slightly less convex and darker in colour. The antennae are 8-jointed as in *elongatum*, but joints 3 and 4 are longer and 5 shorter, giving the following range:—(1) 34–40, (2) 41–51, (3) 59–68, (4) 44–61, (5) 61–71, (6) 24–34, (7) 24–27, (8) 37–41.

The most striking difference, however, is found in the marginal spines which are long (58μ) and close together, averaging 34μ apart. Stigmatic spines (3) with the laterals relatively short and slender and the median long, curved and linear.

Habitat: On native thorn tree, *Acacia caffra* (?), Pretoria; collected by the writer, September 1914.

Collection No.: 116.

197. **Lecanium filamentosum,** Newst.

Lecanium (*Eulecanium*) *filamentosum*, Newst., Bull. Ent. Res. iv, p. 74, 1913.

Adult ♀ about 6 mm. long and 4 mm. broad, flatly convex with a slight median ridge. The colour of dried material is pale brown, with median area white as though covered by a dense layer of white secretion, which gradually fades towards the margin where numerous black dots are evident. The margin is faintly indentate, this character being intensified by the lines of black dots running to the edge and the distinct marginal glassy fringe. Seen from below the insect is brown, with four conspicuous stigmatic bands.

The antennae are 8-jointed with joint 3 remarkably long. A series of ten measurements gave the following range in μ:—(1) 57–65, (2) 68–82, (3) 150–187, (4) 75–88, (5) 65–75, (6) 34–44, (7) 31–37, (8) 54–58.

The integument is characterised by a few scattered, short, conical spines and a number of small, indistinct, "rosette" gland openings. The anal plates are about 220μ long each, with a stout apical spine and several others on the disc.

The marginal spines are comparatively short (37μ), truncate, with the extremity slightly forked. They are set at an average distance of about 50μ apart. The stigmatic clefts are deeply indented but not recessed; each with about 8 spines, of which the laterals are comparatively long and stout (60μ); the middle spine is only a little longer, but stouter. The tarsal digitules are very long and slender; those of the claw are short and very broad.

Habitat: On fig, Cathcart, C. P.; collected by L. J. Botha, July 1918.

Collection No.: 314.

198. **Lecanium proteae,** sp. n.

Adult ♀ about 6 mm. long and 4·5 mm. broad (longest specimen seen reaches 8 mm. by 6 mm. broad); colour, when alive, asphodel green (Ridgway) with very narrow margin of pale dull green yellow. The dorsum is dull coriaceous, giving the insect the colour and appearance of the leaf, the green body corresponding with the blade and the yellowish margin with the midrib or edge of the leaf.

The anal plates are small, yellowish in colour, except in old specimens, in which they are tinged with brown.

In form the insect is uniformly oval, except when situated near the midrib or edge of a leaf, when the form is irregular. Above, the body is moderately convex. Below, the insect is uniform green in colour. In boiling KOH it turns to orange yellow then reddish brown. After treatment the derm is colourless.

Anal plates about 205μ long, outer angles rounded, apices attenuated, with two apical spines, one subapical and one on the disc at about one-third the length from the apex. Anal ring with 6 long hairs. On the dorsum, immediately behind the anal opening, are two scattered groups of "rosette" glands, and there is a further transverse series on the segments immediately anterior to the two groups. The integument is otherwise clear, but has scattered hairs of varying lengths.

Stigmatic clefts shallow, with short, varying, clubbed processes.

Antennae usually 7-jointed with the fourth showing a pseudarticulation; sometimes 8-jointed; 7-jointed form: (1) 27, (2) 37–41, (3) 51–58, (4) 44–48, (5) 20–24, (6) 20–24, (7) 41–54μ; 8-jointed form: (1) 27, (2) 41, (3) 61, (4) 34, (5) 31, (6) 20, (7) 20, (8) 51μ.

Leg II: coxa 54 by 65, femur + trochanter 127 by 37, tibia 95, tarsus 17, claw 20μ.

Marginal spines very short (17μ) at very wide intervals, averaging at least 80μ apart, simple, truncate.

Male scale of the usual type, 2·0 mm. long and 1·2 mm. broad. Head and body, without genital sheath, 1·6 mm. long. Head and prothorax rufous to nearly black, glistening; body reddish, tip of abdomen and spine lighter, yellowish; legs dark, slightly darker than antennae. Caudal filaments, two, white, about as long as the head and body without antennae. Wings whitish, 1·6 mm. long, mealy, with a subcostal reddish line running three-fourths of length of wing from the base. Antennae 1 mm. long, of ten joints.

Larva, newly emerged, 0·5 mm. long and 0·25 mm. broad, orange yellow, very active.

Habitat: On leaves of *Protea*, Pretoria; common.

Collection No.: 108.

199. **Lecanium wistariae,** sp. n.

Adult ♀, mounted specimens about 3·4 mm. long by 2 mm. broad, elongate, tapering to each end. The following description, taken from the Cape Journal, was made from fresh material :—

"Young appearing August 15th; females apparently viviparous, since, while bodies are filled with eggs, only living young are seen under the scales.

"Female long oval, highly convex. Ground-colour yellow obscured by reticulations of black; the black enclosing minute, almost round patches and bounding larger patches of irregular shape and size; in a few specimens there is an obscure median stripe of yellow, but this is never well defined and generally altogether lacking. A tinge of red or rose is apparent about the whole margin of some specimens and this in a few extends as a flush over the whole dorsum."

Antennae 8-segmented; range: (1) 30–34, (2) 36–42, (3) 54–62, (4) 34–44, (5) 48–52, (6) 26–30, (7) 20–24, (8) 34–38μ.

Leg I: coxa 54 by 70, femur + trochanter 170 by 40, tibia 130, tarsus 68, claw 20μ. The tarsal digitules are slender and clubbed.

Margin with a series of slender spines, 44μ long, not truncate. Stigmatic cleft spines similar but stouter. Anal plate 125μ long.

Habitat: On wistaria, Uitenhage, collected August 1901; Cape No. 1286. Thickly clustered on thin twigs of plant; also said to be on rose and Australian myrtle.

Collection No.: 113.

200. **Lecanium durbanense,** sp. n.

Adult ♀ about 5 mm. long and 4 mm. wide, broad egg-shaped, with the extremities broadly rounded. The anterior end narrows perceptibly just in front of the middle. Body flat, mahogany-brown, with the margins and a faint median ridge somewhat darker, glossy.

When mounted, the most striking character under the low power is the chitinisation of the dorsum. In a specimen measuring 5 mm. in length a conspicuous chitinised line proceeded from the anal lobes along the middle of the dorsum to the level of the mouth-parts. A faint chitinised band was also noticeable around the margin.

The antennae are 7-or 8-jointed, with the following range in μ :—8-jointed series: (1) 27-34, (2) 34–41, (3) 37–51, (4) 34–48, (5) 41–44, (6) 27, (7) 27–31, (8) 44–51; 7-jointed series: (1) 27–34, (2) 37, (3) 37–51, (4) 37–41, (5) 41–44, (6) 37–51, (7) 48–51.

Leg I: coxa 88, femur + trochanter 187, tibia 119, tarsus 82, claw 20μ.

Anal plates about 156μ long, comparatively slender. The marginal zone appears more chitinous than the median area with the exception of the ridge previously mentioned. The chitin of the zone appears stippled; that of the median ridge has numerous small oval transparent spots. The marginal spines are very wide apart (110μ), and comprise a single row of short conical spines. The stigmatic clefts are recessed in the form of narrow deep cups; each contains two short (27μ) blunt spurs at the base.

Scattered over the integument are a few comparatively long hairs, which are particularly noticeable in the region of the antennae.

Habitat: On leaves of plant, species undetermined, Durban; collected by C. P. v. d. Merwe, April 1916.

Collection No.: 126.

Genus **Saissetia,** Deplan.

Adult ♀ usually very convex or hemispherical, and the integument very dense, dark in colour, and hard at maturity, with cell-like markings; legs and antennae well-developed.

201 **Saissetia hemisphaerica** (Targ.).

Lecanium hemisphaericum, Targ., Studii sul. Cocc. pp. 26, 27, etc., 1867.

Chermes anthurii, Bdv., Ent. Hort. p. 328, 1867.

Chermes filicum, Bdv., Ent. Hort. p. 325, 1867.

Chermes hibernaculorum, Bdv., Ent. Hort. p. 337, 1867.

Lecanium coffeae, Sign., Ann. Soc. Ent. Fr. (5) iii, p. 435, 1873.

Lecanium beaumontiae, Dougl., Ent. Mon. Mag. xxiv, p. 95, 1887.

Lecanium clypeatum, Dougl., Ent. Mon. Mag. xxv, p. 58, 1888.

Lecanium hemisphaericum var. *hibernaculorum*, Ckll., Bull. Bot. Dept. Jamaica, p. 71, 1894.

Lecanium hemisphaericum var. *filicum*, Green, Ent. Mon. Mag. xxxiii, pp. 70, 77, 1897.

Lecanium (*Saissetia*) *coffeae* var. *clypeatum*, Ckll. & Parr., The Industrialist, p. 164, 1899.

Saissetia hemisphaerica, Ckll., The Ent. Student, ii, p. 32, 1901.

Coccus coffeae, Kirkaldy, Fauna Haw. iii, pt. 2, p. 105, 1902.

Adult ♀ approaching hemispherical, ovate, with the margins somewhat flattened; dorsum smooth, shining, light to red-brown, about 2 to 4 mm. long, 1 to 2·5 mm. broad, and 1·5 to 2 mm. high. In the young forms an indistinct H is sometimes indicated on the dorsum, but this disappears in the adult, which is thus readily distinguished from *S. oleae*.

Integument with numerous clear, oval derm cells. Antennae 8-jointed, with the following range in μ: (1) 37–45, (2) 47-54, (3) 74–81, (4) 46–51, (5) 44–53, (6) 27–34, (7) 24–30, (8) 48–54.

Leg III: coxa 110, femur + trochanter 255, tibia 185, tarsus 88, claw 24μ.

Anal plates about 136μ long, triangular, with rounded corners. Marginal spines flattened at the ends, which are serrated in a variety of forms, some simple; stigmatic spines all strong and blunt; median longer than laterals.

Habitat: On pot-plants, Capetown, Grahamstown (C. P.), Durban and Pietermaritzburg (Natal), and Pretoria and Johannesburg (Transvaal).

Collection No.: 120.

202. **Saissetia oleae** (Bernard).

Chermes oleae, Bern., Mem. d'Hist. Nat. Ac. Marseille, p. 108, 1782.
Coccus olea, Oliv., Ency. Meth. vi, p. 95, 1791.
Coccus palmae, Haw., Tr. Ent. Soc. Lond. p. 307, 1812.
Coccus testudo, Curt., Gard. Chron. p. 444, 1843.
Coccus cycadis, Bdv., Ent. Hort. p. 323, 1867.
Lecanium cassiniae, Mask., N. Z. Trans. xxiii, p. 15, 1890.
Lecanium oleae var. *testudo*, Ckll., Check List, p. 331, 1896.
Lecanium oleae var. *mirandum*, Ckll. & Parr., Biol. Centr. Am. ii, pt. 2, p. 12
Coccus oleae, Kirkaldy, Fauna Haw. iii, pt. 2, p. 106, 1902.

Adult ♀ short ovate, high convex to almost hemispherical, 2·5 to 4 mm. long, 1·5 to 3 mm. broad, and 1·5 to 2·5 mm. high. The dorsum has one longitudinal and two transverse ridges forming a distinct H, dark brown, often dotted with minute flecks of white wax. Derm with elongate cells, each enclosed in an irregular, polygonal tessellation.

Antennae 8-jointed, the segments measuring in μ: (1) 34, (2) 44–48, (3) 66–75, (4) 35–42, (5) 24–37, (6) 24–32, (7) 24–32, (8) 44–51.

Leg I: coxa 78, femur + trochanter 170, tarsus 85, claw 24μ

Anal plate about 176μ long. Marginal spines simple or flattened at apex.

Habitat: On a variety of plants, fairly common throughout the Union.

Collection Nos.: 122 and 122a.

A distinct variety of this scale, characterised by being larger and flat, without the dorsal H, is often found associated with typical *oleae* on oleander at Capetown. Its microscopic characters agree with *oleae* with the exception that antennal joints 2 and 4 are a little longer (*Coll. No.*: 122a).

203. **Saissetia nigra** (Nietn.).

Lecanium nigrum, Nietn., "Enemies of Coffee-tree," p. 9, 1861.
Lecanium depressum, Targ., Studii sul. Cocc., p. 29, 1867.
Lecanium begoniae, Dougl., Ent. Mon. Mag. xxviii, p. 209, 1892.
Lecanium nigrum var. *depressum*, Ckll., Check List, p. 332, 1896.
Saissetia depressa, King, Psyche, ix, p. 296, 1902.
Saissetia nigra, King, Psyche, ix, p. 296, 1902.
Saissetia nigrella, King, Psyche, ix, p. 296, 1902.
Coccus nigrum, Kirkaldy, Fauna Haw. iii, pt. 2, p. 106, 1902.

Adult ♀ long oval to broad ovate, low convex, shining black, 3 to 4 mm. long. Marginal spines scattered, simple, about 40μ long. Antennae of 7 or 8 segments, 7-jointed series with 4 longest, 8-jointed series with 3 longest; range in μ:—8-jointed series: (1) 27, (2) 37-41, (3) 58–68, (4) 34–44, (5) 34–41, (6) 24, (7) 24, (8) 51–54; 7-jointed series: (1) 27, (2) 34, (3) 54, (4) 68, (5) 24, (6) 20, (7) 58.

Leg I: coxa 58, femur + trochanter 170, tibia 116, tarsus 68, claw 20μ.

Anal plate about 170μ long.

Habitat: On *Ficus* spp., Bayville, C. P., and Natal coast.

Collection No.: 123.

204. **Saissetia perseae,** sp. n.

Ova and larvae small, purplish red in colour, found beneath dry body of adult ♀ attached to mid-rib of leaf. Larvae about 0·35 mm. long and 0·18 mm. broad, almost oval, slightly broadest between the second and third pairs of legs, broadly rounded in front and regularly cleft behind, with two caudal spines equal in length to the greatest width of the body. The eyes are deeply pigmented.

The antennae are six-jointed; segment 2 a little shorter than 1; 3 is long (27–30μ), almost equal to 6; 4 and 5 are shorter and almost equal (13μ and 15μ). There is a distinct notch near the distal end of 3, and another at about the middle of 5, from which points long hairs arise. The terminal segment has a long apical spine, two others of about three-fourths its length, and several shorter hairs. Claws simple; upper digitules long, straight, with small globular knobs; lower digitules shorter, also with small clubs. Margin with thin short spines; at level of spiracles on each side there are two stout blunt spines, about 15μ long, pointing obliquely backwards. Anal bristles reaching level of hind-margin, or nearly so.

Adult ♀ 4·2 mm. long, 3 mm. broad, pointed at each end, but more so in front, with the dorsum quite flat. In colour it is blackish brown, and of a dull matt appearance, entirely without design or marginal appendages. The margin is entire, with a very slight notch at the two spiracles on each side. Seen from below the extreme margin is thin; the legs and antennae pale, and there are four faint lines, two on each side, representing stigmatic bands. There is no trace of an anal cleft when examined with a hand-lens. When crushed the body-contents are purple in colour. Placed in hot KOH solution the body becomes hard and curls so much that it is difficult to make a satisfactory mount.

The integument on the dorsum is extremely dense, hard and brittle when cleared; that of the venter is thin, hyaline, and very delicate. The legs and antennae are colourless. The anal cleft is entirely absent, with the exception of a very short space posterior to the anal plates. Beyond this it is merely indicated as a line between the polygonal "cells" of the dorsum. Polygonal cells with straight sides, each with a very small transparent spot appearing as a point under the microscope. The space occupied by the anal plates is clear, faintly yellow, a striking contrast to the deep brown of the remainder of the dorsum when cleared. The inner face of the plates is straight; the outer margin regularly curved to the tip giving them a broad heart-shape. (Fig. 243). The polygonal cells are fairly uniform in size to near the margin where they gradually disappear into the thin ± structureless marginal area. Eye-spots distinct.

The antennae are 8-jointed. Joints 2, 4, 6 and 7 sub-equal; 1 a little shorter, 3, 5 and 8 longer. Measurements in μ: (1) 30, (2) 37, (3) 47, (4) 30, (5) 50, (6) 30, (7) 27, (8) 47.

Habitat: On upper side of leaf of avocado pear (*Persea gratissima*), from Mrs. Godwin, Durban, May 1916.

Collection No.: 103.

This species is remarkable for the hardness of the integument at maturity and the fact that the anal cleft is obsolete in the later stages. It differs from *Hemilecanium*, however, in lacking the four perforate areas on the dorsum.

205. **Saissetia kellyi,** sp. n.

Adult ♀ almost circular, but rather wider than long (11·5 mm. by 13 mm.), flat, closely adherent to stem, deep chestnut in colour, with the dorsum matt, without ridges or lines of any kind, but flatly bounded to thin margin, often covered with dust, etc., so as to appear like a large flat blister on the bark. Younger specimens rather lighter in colour, with faint radiating ridges from the somewhat raised median area.

The following particulars concerning antennae, legs, and microscopic characters in general, refer to insects measuring approximately 7 mm. long, i.e., before chitinisation was fully complete.

Antenna 9-jointed, range in μ: (1) 48–54, (2) 85–102, (3) 129–153, (4) 75–85, (5) 58–65, (6) 105–116, (7) 44–51, (8) 34–48, (9) 74–79.

Leg I: coxa 153, femur + trochanter 357, tibia 245, tarsus 153, claw 31μ.

Anal plate about 320 μ long. The margin has a single row of short, stout, conical spines. Stigmatic cleft with 3 gradually tapering spines, laterals about 50μ, median about 136μ.

Around the body, just within the margin, is a series of complex, tubular glands, about 40 in number, distributed at almost regular intervals. Scattered over the integument, particularly near the margin, are numerous, short, stout, glandular hairs. The thin marginal area has the usual ± straight, sided polygonal cells; the median area has elongate oval cells much like those of *Hemilecanium theobromae*, Newstead.

Habitat: On thick stems of *Acacia melanoxylon*, Pietermaritzburg, Natal; collected by A. Kelly, June 1915.

Collection No.: 118.

The anal cleft is quite obsolete in mature specimens. This character, together with the two distinct types of cells on the dorsum and the 9-jointed antennae, reminds one of the type species of the genus *Hemilecanium*, Newst., but the absence of the four perforate areas preclude this species from that genus.

206. **Saissetia persimilis,** Newst. (Plate i., fig. 234).

Lecanium (*Saissetia*) *persimile*, Newst., Bull. Ent. Res. vii, p. 362, 1917.

"Female, adult. Not differing appreciably in its external form, colour, and density of chitin from *Lecanium* (*Saissetia*) *oleae* (Bernard), but in two examples the dorsum was covered with a fine dusky-white, mealy secretion. The median longitudinal and two transverse ridges, forming roughly the letter H, well marked in two specimens, but absent in another. Anal cleft completely fused. Anal lobes attenuated, outer angle broadly rounded, inner edge much the longest; apex bluntly pointed with one or two short spines. No stigmatic clefts; spines three, the central one slightly more than twice the length of the laterals. Antennae well developed, of eight segments. Legs rather slender; lower digitules very robust, incrassate proximally, dilated distally. Derm thickly studded with small, but well-defined, oval and translucent cells; these are much more crowded together at the margin and also larger." (Newstead).

Newstead states that *Lecanium* (*Saissetia*) *sylvestrii*, Leon., has some similarity to *persimile*, but the former has 7-jointed antennae and *three* transverse ridges across the dorsum.

Habitat: On *Combretum*, Muckleneuk, Pretoria; collected in October 1914.

Collection Nos.: 115 and 124.

207. **Saissetia subpatelliforme,** Newst. (Plate i., fig. 237).

Lecanium (*Saissetia*) *subpatelliforme*, Newst., Bull. Ent. Res. vii, p. 366, 1917.

Adult ♀ large, reaching 7 mm. long, 5 mm. broad at the base and 3·5 mm. high, very convex but ± conical, with the margin at the base slightly produced as a rounded ridge. The colour is dark castaneous to almost black, slightly shining, and without white flecks. There is no dorsal H, nor prominent ridges of any form (fig. 237).

Younger forms are lighter in colour, flat, disc-like, with the margins slightly raised and rounded and the median area wrinkled. The anal cleft is apparently obsolete and the anal lobes inconspicuous.

Antennae 8-jointed; range in μ: (1) 37–47, (2) 35–51, (3) 75–78, (4) 54–58, (5) 41–54, (6) 24–27, (7) 17–20, (8) 51–58.

Professor Newstead's description, omitting figure references, is as follows:

"Female, adult. Varying from broadly to narrowly ovate, centre generally highly gibbose; surface rather roughened or slightly rugose, often with widely separated patches of secretion, especially at the sides; dorsum (gibbosity) often shining. Derm cells of the median and sub-median areas small, ovate and widely separated, those near the margin much larger. Marginal spines of two kinds: (1) long and rather stout, dilated and divided on both sides; (2) similar, but only about half the length of the long ones. Stigmatic clefts practically obsolete; spines three, the laterals small, stout and pointed; central one missing in all the preparations. Eyes well defined. Antennae of seven or eight segments (both forms present in one ♀). Legs well developed; tarsus almost equal in length to the tibia; lower digitules stout, upper pair normal. Anal lobes with the base and outer edge of equal length, approximately. Anal ring of eight hairs. Anal cleft varying in length from a little less than a third to one-third the length of the body. Length, 3·8–5·2 mm."

Habitat: On stems of *Cedrela toona*, Salisbury, Southern Rhodesia; collected by Rupert Jack, June 1917. Also on stems of *Syringa*, Salisbury; collected by Rupert Jack, February, 1909 (119a).

Collection Nos.: 119 and 119a.

208. **Saissetia oculata,** sp. n.

Adult ♀ elongate, 8 to 9 mm. long by 4 mm. wide, moderately flat, dull, buff to brown in colour, with the eye-spots and anal plates darker, almost black; margin more chitin-brown, with a conspicuous fringe. Dorsum with rows (3) of hairs similar to fringe. Eyes distinct, almost circular, about 165μ in diameter, with darker central prominence. Integument with faint oval cells, widely scattered. In the specimens examined these are most conspicuous around the anal lobes,

the point from which the chitinisation of the integument appears to spread in the LECANIINAE. This suggests that, although the insects examined are adult, they may not be quite mature.

Antennae of 8 segments, range in μ: (1) 37–41, (2) 48–58, (3) 102–112, (4) 58–68. (5) 61–68, (6) 31–34, (7) 27–34, (8) 44–51.

Leg I: coxa 88, femur + trochanter 238, tibia 170, tarsus 102, claw 24μ.

Margin with conspicuous fringe of long spines (136μ) with tips saw-like or finger-like. Dorsum with three longitudinal rows of long (143μ) spines. Anal plates long, tapering (280μ). Stigmatic clefts inconspicuous with two very short spines and one longer (about half the length of marginal spines).

Habitat: On grapevine, Durban; collected by C. P. v. d. Merwe, May 1917. *Collection No.*: 321.

Genus **Hemilecanium,** Newstead.

" Adult female with the posterior extremity not cleft. Anal orifice placed near the middle of the dorsum and closed above with a pair of hinged plates as in *Lecanium*. Larva and nymph with a distinct anal cleft as in *Lecanium*. Female in all stages with four large dorsal groups of compound spinnerets." (Newstead).

209. **Hemilecanium theobromae,** Newst. (Plate i., fig. 238).

Hemilecanium theobromae, Newst., Jl. Econ. Biol. iii, pt. 2, p. 39, 1908.

Professor Newstead's description, omitting figure references, is as follows:—

" Adult female broadly ovate or sub-circular; margins broadly flat, central area suddenly elevated, with strong irregular prominences. The whole of the dorsal area covered with a thin but dense layer of ochreous meal-like wax, but the prominences of the dorsum are generally denuded, apparently through abrasion, appearing through the secretion as shining, piceous, irregularities. Cuticle shining dark piceous on the central elevated area; dark castaneous and strongly rugose at the margins. Venter covered with a rather thick layer of white fibrous secretion. Anal cleft obsolete, but there is usually a faint emargination at the posterior extremity. Anal orifice placed just within the broad elevated dorsal zone at about one-third of the distance from the posterior margin. Derm cells of two distinct types; those of the dark central area narrowly elongate with an apical pore, those of the pale broad margin of the ordinary polygonal type. There are also four groups of spinnerets; two towards the anterior and two towards the posterior extremity, each group composed of several hundred spinnerets forming well-defined dark chitinised areas. Antenna of nine segments, of which the third is the longest; there are a few long hairs on the four terminal segments; formula 3, 4 (5, 2, 9) 6, 1 (7, 8). Legs highly chitinised; slender but small compared with the size of the insect; coxa almost equalling the length of the femur; digitules simple. Marginal spines with their broad bases suddenly contracted, each fitting into a well-defined socket, the latter being attached to a short subcutaneous tube. Stigmatic channels and spines absent.

" Length 13–15 mm.; width 12–13 mm.

"Second stage female broadly ovate, slightly narrowed posteriorly, marginal spines continuous, resembling those in the adult. Antennae of seven segments, the third being the longest, the rest of the segments subequal in length. Legs scarcely longer than the antennae; coxa rather broad. Mentum uniarticulate. Groups of spinnerets occupying relatively the same position as in the adult, but there are only about 60–70 individual spinnerets in each group; they are also larger and more distinctly separated than in the adult. Derm in the region of the anal cleft finely squamose, with a large subcutaneous tube; there is also a similar tube just within the margin opposite the anterior stigmata.

"Larva elongate; position of the compound spinnerets as in the adult and nymph. Mentum monomerous. Antennae of six joints, the third equalling the length of the fourth, fifth and sixth together. Marginal spines forming a continuous series."

Habitat: On tree euphorbia, East London, and stems of oleander, Capetown (Fuller, 1898).

Collection No.: 107.

Genus **Aclerda,** Sign.

Adult ♀ naked, a mere sac containing eggs at maturity, with normal mouth parts, but legs and antennae absent.

Larva greatly elongated, with parallel sides.

210. **Aclerda digitata** (Ckll.).

Pseudolecanium digitatum, Ckll., Ann. Mag. Nat. Hist. (7) ix, p. 24, 1902.

Aclerda digitata (Ckll.) Fernald, Catalogue, p. 210, 1903.

Professor Cockerell's description is as follows:—

"♀, pyriform, with the hind end pointed; about 2½ mm. long; dark ferruginous, shiny, producing some cottony material. End of abdomen strongly chitinized, with the form usual in the genus. The diagnostic characters, as in all species of the genus, are derived mainly from the larva, the female being a mere bag of eggs.

"Larva extremely long and narrow, length 600, breadth 160μ. Anterior extremity truncate, crenulate, with six short blunt, finger-tip-like spines; a row of fifteen blunt spines down each side of body; no dorsal spines; legs well developed, anterior tibia 60, its tarsus 30μ long; the tibia has a constriction about 27 from base, making it look almost 2-jointed, this being more or less apparent on all the legs; tarsal digitules long, with small knobs; claw-digitules shorter, filiform, knobbed. Antennae 24 apart at base and 30μ from anterior end of head; 6-jointed, joints measuring: (1) 18, (2) 12, (3) 27–33, (4) 20, (5) 21, (6) 30. Anal ring small, circular, without bristles on its margin, but posterior to it are set four bristles, of which the inner two are shortest; anterior to anal ring is a row of four finger-like blunt spines; on each side is a caudal bristle, about 190μ long, and beyond each of these a pair of finger-like spines; anterior to and a little laterad of each caudal bristle is a small round gland. The last two segments have each a pair of bristles on the ventral surface, those on the last being twice as long as those on the penultimate segment."

Habitat: On grass, Natal; collected by C. Fuller, 1901. This species has not been found again.

Collection No.: 134.

Genus **Allopulvinaria,** nov.

Adult ♀ naked above, very convex and distinctly segmented. Lower surface concave, filled with a compact powdery mass of wax which projects around the margins. Antennae somewhat rudimentary, of 4, 5 or 6 segments. Legs well developed. Anal ring with numerous (12?) hairs.

Larva elongate and narrow; anal tubercles produced, each with one long seta.

Type, *A. subterranea*, sp. n.

211. **Allopulvinaria subterranea,** sp. n. (Plate vi, fig. 246).

Larva active, pale pink, eyes pigmented, body elongate and narrow. Anal tubercles long, each with one long seta.

One-fourth grown ♀ with 4-jointed antennae, and marginal hairs as in *Lecanium*.

Adult ♀ viviparous, 7 mm. long, 4·5 mm. broad and 4 mm. high. Dorsum roundly arched; segmentation distinct, the segments roundly ridged.

The body is red, faintly flecked with white wax. Underside flatly concave, abdominal portion plainly segmented. Legs small, brown. Anal plates small, brown, from between which protrudes a double fine pencil of white wax. Lower concavity of body filled with cushion of white wax which extends slightly beyond the margin of the body; this is not cottony but compact. No eggs were seen, but larvae were present in the white waxy cushion and in the body of the ♀.

Antennae 4, 5, or 6-jointed, usually 5. Anal ring with numerous (12?) hairs.

Anal plates raised, appearing excavate so as more or less to enclose the anal tube from the sides as well as above. Anal groove closed. Integument with numerous simple glands and short acute spines scattered over the surface; the former especially noticeable in transverse series across the segments.

The following measurements may be useful for comparison.

Antennae: (*a*) 4-jointed type:—

	I	II	III	IV.
(a)	40	27	61	34μ
(b)	34	40	65	54μ

(*b*) 5-jointed series, range in μ:—(1) 34–45, (2) 34–40, (3) 51–68, (4) 15–34, (5) 23–40; (*c*) 6-jointed form, e.g. (1) 41, (2) 34, (3) 61, (4) 17, (5) 10, (6) 20.

Leg II: coxa 81 by 108, femur + trochanter 150, tibia 74, tarsus 74μ.

Habitat: On stems of "quick" grass, near bank of stream; collected by T. L. Watermeyer, Jonkershoek, Stellenbosch, C.P., July 1917.

Collection No.: 138.

Genus **Protopulvinaria,** Ckll.

The few species which have been described in this genus are similar to *Lecanium* in their early stages, but may be readily distinguished at maturity by the small white ovisac which is secreted beneath the adult ♀. In the normal condition this is but slightly larger than the body of the female and protrudes as a white ring around the margins of the body (fig. 248).

This genus is included in *Pulvinaria* by Mrs. Fernald in her Catalogue (p. 128), but it would appear that its correct position is between *Lecanium* and *Pulvinaria*.

212. **Protopulvinaria piriformis** (Ckll.), Lefroy. (Plate ii, fig. 244; iv, fig. 248.)

Pulvinaria (Protopulvinaria) pyriformis, Ckll., Jl. Trin. Nat. Club, i, p. 309, 1894.

Pulvinaria (Protopulvinaria) pyriformis, Ckll., Jl. Trin. Nat. Club, ii, p. 307, 1896.

Pulvinaria newsteadi, Leon., Riv. Pat. Veg. vi, p. 279, 1898.

Pulvinaria pyriformis, Ckll., Psyche, viii, p. 311, 1899.

Protopulvinaria pyriformis, Lefroy, Scale Ins. Lesser Antilles, p. 43, 1901.

Pulvinaria pyriformis, Fernald, Cat., p. 138, 1902.

Pulvinaria plana, Ldgr., Jahrb. Hamb. Wiss. Anst. xxxiii, p. 34, 1911.

Protopulvinaria piriformis, Ldgr., Die Schildläuse, p. 199, 1912.

Ovisac slightly larger than the body of the adult ♀, from which it extends as a uniform ring around the margins (fig. 348). Ova pale greenish white, regularly oval.

Adult ♀ about 3 mm. long and about as broad slightly behind the middle; broadly rounded behind, suddenly narrowing in front so as to be short pear-shaped or drop-shaped. The margins of the body are flat; the central part is flatly rounded. In living specimens the general body colour is yellowish or pinkish with the margins reddish brown. The subdorsal area is irregularly suffused with mauve or violet. The anal cleft is deep, extending almost to the centre of the body, but the sides are in close proximity, so that the posterior margin in most cases appears uniformly broadly rounded. The anal plates are very long and very narrow and are brownish in colour. Dead, dry specimens are pale to deep brown according to age. When stained, cleared and mounted the following characters may be noted:—

Antennae 7-jointed; range in μ: (1) 27–31, (2) 37–44, (3) 44–51, (4) 51–54, (5) 20–24, (6) 20–24, (7) 51–54.

Leg I: coxa 75, femur + trochanter 170, tibia 109, tarsus 54, claw 20μ.

Leg II: coxa 99, femur + trochanter 180, tibia 112, tarsus 68, claw 24μ.

Anal plates very long (470μ) and narrow (fig. 244).

Marginal spines short, thin, with ends deeply branched, or occasionally bifid from base, in a close-set series. Stigmatic spines 3, laterals short and acute, median two or three times as long. Young form, about 1·2 mm. long, oval, translucent, appearing faintly greenish yellow, with six deep purple lines radiating from median area to margin, the four posterior being nearer together than the anterior two.

Habitat: On undersides of leaves of avocado pear (*Persea gratissima*); collected by A. Kelly, Pietermaritzburg, April 1916.

Collection No.: 77.

Genus **Pulvinaria**, Targ.

"Adult female resembling *Lecanium* in the early stages and until the commencement of oviposition, when a loose cottony ovisac is secreted from below the posterior extremity of the insect, for the protection of the eggs. The body of the insect is tilted up during the formation of the ovisac, and often becomes much shrivelled and distorted, finally remaining as a small shapeless scale at the anterior extremity of the mass of ovisac. It is sometimes rendered still more inconspicuous by the partial overlapping of the secretionary matter, but is never completely enveloped. In all purely structural characters there is nothing to distinguish species of this genus

from those of *Lecanium*, so much so that, until the period of oviposition, it would be impossible to determine whether an individual should be placed in the one or the other genus." (Green).

213. **Pulvinaria aristolochiae,** Newstead. (Plate ii, fig. 242).

Pulvinaria aristolochiae, Newst., Bull. Ent. Res. viii, p. 19, 1917.

Adult ♀, immediately prior to forming the ovisac, about 8 mm. long and 4·5 mm. broad, with thin margins and the dorsum rising to a distinct central prominence: colour brown, with darker markings. The margin is supplied with a short fringe of thin pale hairs; from this to the raised centre extend a number of dark lines.

Male puparium about 3 mm. long, moderately convex, dull white, not glassy, with a distinct transverse ridge about the middle. Two white filaments protrude from the posterior extremity some days prior to the emergence of the adult ♂. Adults were emerging in July 1916.

Antennae 8-jointed, range in μ:—(1) 57–75, (2) 68–75, (3) 187–190, (4) 95–102, (5) 78–85, (6) 34–47, (7) 24–34, (8) 41–44.

Leg I: coxa 185, femur + trochanter 400, tibia 262, tarsus 123, claw 34μ.

Anal plate about 250μ long. Marginal spines short (27–35μ), many appearing truncate.

As Professor Newstead did not have the opportunity of examining living material the above particulars are given to supplement his description which is as follows:—

"Female, adult. More or less cordate in outline and rather flattened; dorsum almost completely covered with a well-defined layer of flake-like wax which varies in colour from dirty grey to greyish brown. Antennae of eight segments; 3rd, 4th and 5th unusually long, the two first-named swollen distally; 3rd about twice the length of the 4th; three long hairs on 2nd, one of which lies (in three examples) close up to the succeeding segment; there is also a long distal hair on the 3rd; two on the 5th; a single spine on the 6th, 7th and 8th, the last-named also with a few very short hairs. Legs stout, long; tarsus relatively very short, less than one-third the length of the tibia; lower digitules long and very broadly spathuliform. Marginal spines stout, pointed, and placed rather close together; stigmatic spines broken away in all the specimens, their points of attachment being continuous with the marginal series. Submarginal pores very large, continuous, but rather widely separated. Anal lobes with four stout spines near the apex, on the inner edge. Anal cleft short, usually a little less than one-sixth the entire length of the body. Anal ring with eight hairs. No derm cells present; but there are numerous circular spinnerets (? ventral), each having an inner concentric ring. Length 5·7–7·6 mm.

"Ovisac pure white and closely felted, long and generally tortuous. Length 10–20 mm."

This insect shows great similarity to *P. jacksoni*, Newstead. Both have remarkably long joint 3 to the antennae, which in *jacksoni* is almost 120μ, in *aristolochiae* about 180μ. Further both produce extremely long ovisacs.

Habitat: On stems of *Erythrina caffra* Thunb., (Kaffir-boom), Natal Coast.
Collection Nos.: 79 and 84.

214. **Pulvinaria floccifera** (Westw.).

Coccus floccifera, Westw., Gard. Chron., p. 308, 1870.

Pulvinaria brassicae, Ckll., Can. Ent. xxvii, p. 135, 1895.

Pulvinaria floccifera, Green, Ent. Mon. Mag. xxxiii, p. 72, 1897.

Pulvinaria phaiae, Lull, Ent. News, x, p. 237, 1899.

Pulvinaria floccosa, Newst., Jl. Roy. Hor. Soc. xxiii, p. 26, 1900.

Completed ovisac about 6 mm. long and 3 broad, with parallel sides and rounded extremity; pink in colour, from the numerous ova which are of that colour; the small amount of white cottony matter which is incorporated in the mass is inconspicuous owing to the large number of eggs.

♀, young stage: about 2 mm. long, translucent greenish yellow, with the median dorsal area suffused with a pinkish or brownish tint.

Adult ♀ about 3 mm. long and almost as broad, moderately convex. The margins are pale translucent greenish yellow, the median dorsal area is reddish brown and the whole dorsum is more or less wrinkled. The crests of the ridges, especially those running to the margin, blackish brown. Anal plates small, of the same colour as the dorsal area or slightly paler. When the ovisac is almost complete, the body of the ♀ has shrunken to such an extent that the brownish part of the dorsum is not conspicuous, while the black crests of the ridges are close together and thus give the insect a much darker appearance.

Antennae 8-jointed, range in μ: (1) 34–38, (2) 44–51, (3) 65–72, (4) 34–44, (5) 34–41, (6) 24–27, (7) 24, (8) 44.

Leg I: coxa 78, femur + trochanter 190, tibia 163, tarsus 102, claw 24μ.

Upper digitules very long, slender, with spherical knobs. Lower digitules stout, normal. Anal plate about 145μ long. Just in front of the anal plates there are a few scattered, "rosette" glands and two pairs of long (108μ) hairs. Marginal spines about 50μ long and 100μ apart, slender, often with finely divided tips, alternating with a submarginal row of similar hairs of about half the size. Stigmatic spines comparatively short and stout, with the outer ends tapering to blunt points. From these to the spiracles extends a double row of small rosette glands.

Puparium of ♂ of the usual type with the segments of the plates very distinct. The whole puparium is opaque white, appearing finely striate in a longitudinal direction.

Habitat: On a native plant (*Solanum* sp. ?) Durban; collected by C. P. v. d. Merwe, July 1916.

Collection No.: 82.

A very large percentage of the young forms (about 1·5 mm. long) are very convex and shiny black, obviously parasitized.

215. **Pulvinaria jacksoni,** Newst.

Pulvinaria jacksoni, Newstead, Jl. Econ. Biol. i, p. 155, 1908.

Professor Newstead's description is as follows:—

"Ovisac from two and a half to seven times the length of the female; breadth equal to the width of the insect; low convex, sides parallel; closely felted, tough and web-like in texture. Length 16·75–42 mm.

"Adult female—Dried examples sienna brown or dull ochreous; the pale examples with yellowish mottlings indicating the position of the derm-cells. Form normal. Antennae of eight segments, the third being much the longest; last four subequal; there is a very long hair on the third and fifth, the one on the former the longest. Legs stout; trochanter about one-third the length of the femur, with a very long apical hair; digitules to claws and tarsi normal. Derm with very small inconspicuous glands. Marginal spines short, closely set, truncate, the ends often notched. Stigmatic clefts with pointed spines and two large tubercles.

"Male puparium, much stained with brown, normal in shape, but thick and unusually wax-like in appearance; dorsal plate with one large central, white, wax-like felted spot and several brownish tubercles immediately beyond it. Length 2·25 mm."

The following measurements are added for comparison with the other South African species :—

Antennae 8-jointed; range in μ: (1) 48–54, (2) 54–68, (3) 102–116, (4) 68–75, (5) 61, (6) 31–34, (7) 31–34, (8) 37–41.

Leg I: coxa 139, femur + trochanter 354, tibia 230, tarsus 108, claw 27μ.

Anal plate about 240μ long.

Habitat: On *Trichilia* sp., Durban; collected by A. Kelly, May 1918.

Collection No.: 79a.

216. **Pulvinaria lepida,** sp. n.

Adult ♀♀ with ovisacs clustered on stems and leaves of grass.

Adult ♀ averaging 2 mm. long by 1·3 mm. broad, moderately arched, light brown in colour, dorsum with transverse wrinkles; marginal area flecked with white wax. Ovisac white, elevated, extending behind the insect for about the length of ♀ body, faintly fluted on upper surface.

Numerous ♀♀ parasitised. Mounted specimens contain numbers of well developed embryos.

Antennae variable, of 7 or 8 segments; terminal joint appearing truncate; range in μ:—7-jointed: (1) 34–37, (2) 37–48, (3) 54–65, (4) 70–82, (5) 24–27, (6) 24–27, (7) 37–41; 8-jointed: (1) 34–37, (2) 44–48, (3) 51–58, (4) 34–41, (5) 44–48, (6) 24–27, (7) 24–27, (8) 37–41.

Leg I: coxa 78, femur + trochanter 187, tibia 153, tarsus 102, claw 24μ.

Anal plate about 153μ long, with 5 comparatively short hairs at the apex. Marginal spines in a single row, simple, pointed, about 41μ long and 20–30μ apart, straight or only slightly curved. Stigmatic spines: laterals short, acute; median stouter, longer, blunt.

Habitat: On stems and leaves of common veld grass, Standerton and Pretoria. (K. Munro).

Collection Nos.: 139 and 328.

217. **Pulvinaria mesembryanthemi** (Vallot), Sign. (Plate i, fig. 235).

Pulvinaria mesembryanthemi, Vall., Bull. de Ferussac, xxii, p. 469, 1830.

Calypticus mesembryanthemi, Costa, Ann. Acad. Asp. Naples, p. 273, 1844.

Pulvinaria biplicata, Targ., Catalogue, p. 34, 1869.

Pulvinaria mesembryanthemi, Sign., Ann. Soc. Ent. Fr. (5) iii, p. 39, 1873.

Adult ♀ to time of forming ovisac, and younger stages, green, of the same tint as the fleshy leaf of *Mesembryanthemum edule*, its most common food-plant; attaining a length of 5 mm. and an almost equal breadth, moderately convex, dorsum smooth.

As the ovisac is produced the body of the ♀ becomes yellowish and later yellowish brown, much shrunken, with four transverse ridges and, ultimately, contorted or bent backward (fig. 235).

Antennae 8-jointed; range in μ: (1) 48–55, (2) 48–54, (3) 75–85, (4) 44–58, (5) 27–37, (6) 24–34, (7) 27–31, (8) 46–51.

Leg I: coxa 122, femur + trochanter 290, tibia 211, tarsus 126, claw 34μ.

Anal lobes approximately 165μ long.

This insect is common throughout South Africa on *Mesembryanthemum* spp., especially *M. edule*, Linn. It becomes so numerous in some seasons that it kills patches of this plant when grown in parks, etc. This was the case at the Eastern Sports Grounds, Pretoria, in November 1914.

The ♂♂ emerged from the next generation about Christmas 1914 and the following particulars are given from fresh material obtained at that time :—

Male test, transparent, white, glassy, about 1·5 mm. long, margins depressed, central plate raised, slightly keeled.

Body, legs and antennae dark brown. Wings broadly rounded, iridescent, dorsal sclerites and eyes shiny black. Two caudal waxy filaments, white, as in *Pseudococcus*, length equal to head + body without antennae.

Length of head + body 1·17 mm. (without genital spike); length of wing 1·0 mm.; width of wing 0·5 mm.; length of antenna 0·84 mm.; length of genital spike 0·27 mm.; length of caudal setae 1·0 mm.

Antennae 10-jointed, the segments measuring: (1) 34, (2) 48, (3) 51, (4) 180, (5) 112, (6) 105, (7) 85, (8) 68, (9) 61, (10) 74μ.

Habitat: On *Mesembryanthemum* spp., chiefly *M. edule*, Linn., throughout the Union.

Collection No: 78.

218. **Pulvinaria psidii,** Mask.

Pulvinaria psidii, Mask., N.Z. Trans. xxv, p. 223, 1892.

Adult ♀ pale transparent yellow with irregular black markings; 2 mm. long and 1·7 mm. broad. The ovisac is white, as wide as the body, always *flat*, attaining twice the length of the body. Ova pale yellow.

Larvae pale yellow, hatching when received, 16th November 1914.

Adult ♀ flatly convex with slightly raised median keel. Anal plates pale brown.

Antennae 8-jointed; range in μ: (1) 24–34, (2) 37–44, (3) 51–58, (4) 27–34, (5) 27–34, (6) 20–24, (7) 14–20, (8) 41–44.

Leg I: coxa 68, femur + trochanter 190, tibia 145, tarsus 85, claw 27μ.

Anal plate about 130μ long. Margin with a row of thin spines about 34μ long, tips divided but not dilated. These spines are set much closer together on the anterior part of the body. Integument clear, with a few simple glands with short

spines and a few long hairs near the insertion of the antennae. Stigmatic spines; laterals short, conical; median longer (51μ).

Habitat: On guava, Botanic Gardens, Durban; collected by A. Kelly, November 1914.

Collection No.: 81.

Genus **Ceronema,** Mask.

Maskell's original diagnosis of this genus, as given in the Transactions of the New Zealand Institute, p. 55, 1894, is as follows:—

"Female insects in the adult stage covered wholly or partially by tests of threads more or less closely woven, neither glassy nor felted, never forming homogeneous plates. No fringe. Form of insect Lecanid, with normal cleft and lobes.

"*Larva Lecanid, showing cleft and lobes.*

"Male pupa covered by a glassy test of normal Lecanid form, composed of plates more or less homogeneous."

219. **Ceronema mobilis,** sp. n.

Adult ♀ about 3 mm. long, broad oval in outline, flat, with the dorsum almost entirely covered with long, white, waxy filaments. Around the margin the filaments are long and coarse, but those on the dorsum are short and fine and ± curly and densely matted and appear almost felted. The colour of the insect, beneath the secretion, is caramel brown.

When cleared and mounted the body is broad oval; integument thin and transparent with numerous scattered, small, simple gland openings. Margin very closely set with a very short fringe of marginal spines, which are only about 20μ long, thin, linear, two or three, usually two, arising from the same pore; they are unusually close together, averaging about 14μ apart. Stigmatic clefts shallow, but distinct because of their chitinised sides; each cleft with two or three curved, blunt processes which are about as long as the marginal spines.

Antennae 7-jointed; range in μ: (1) 27–37, (2) 41–51, (3) 34–54, (4) 68–78, (5) 27–31, (6) 17–27, (7) 41–44. Joints 2 and 4 each with two long setae, 5 with one, 6 with two and 7 with eight.

Leg I: coxa 75, femur + trochanter 187, tibia 105, tarsus 68, claw 24μ.

Anal plate about 140μ long with 1 apical and 3 subapical spines.

Habitat: On leaves of common native bush (*Celastrus cordata*, E.M.) (Celastrineae); collected by C. Fuller, Illovo River, Natal, August 1916.

Collection No.: 97.

The adult ♀ moves about quite readily. A number of mature specimens were put on one side when received with a view to photographing them, but next day, when the leaves had slightly dried, the insects had all crawled off and so disarranged the waxy filaments.

Genus **Lichtensia,** Sign.

Adult ♀ oval or suboval, like a *Pulvinaria*, except that the secretionary sac covers the whole body with the exception of the cephalic end, which is usually more or less exposed. Antennae 8-jointed.

220. **Lichtensia asparagi,** sp. n.

Female ovisac about 4·5 mm. long, elongate, narrow and very convex, sordid white in colour, thin but dense, with the anterior extremity open, exposing the front portion of the dry female.

Male puparium moderately large, elongate, very convex, with perpendicular sides, thin, semi-opaque, dorsum flatly rounded, entirely without median plate. There is a faint indication of sublateral lines, otherwise the surface is uniformly stippled.

Adult ♀, mounted, broad oval, about 4 mm. long, with the two extremities about equally rounded; anterior extremity not produced.

The integument appears remarkably free from conspicuous glands or hairs. Margin with a single scattered row of short sharp curved spines. Stigmatic spines stout, somewhat curved, with rounded ends.

Antennae 8-jointed, in one antenna examined 9-jointed, with the following range in μ: (1) 35–48, (2) 57–60, (3) 68–78, (4) 51–71, (5) 40–61, (6) 30–37, (7) 25–34, (8) 30–38.

Leg I: coxa 88, femur + trochanter 228, tibia 190, tarsus 102, claw 24μ.

Anal plate about 185μ long, with longitudinal folds.

Habitat: On *Asparagus capensis*, L. (Liliaceae), Eastern Cape Province.

Collection No.: 131.

Genus **Filippia,** Targ.

Female flat, oval, legs and antennae normal. Side of body and dorsum with numerous tubular glands. Female, at maturity, entirely enclosed in a flat felted sac which, after oviposition, serves as an ovisac.

221. **Filippia chilianthi,** sp. n.

Adult ♀ entirely covered with a dense, closely felted layer of white secretion, about 6 mm. long and 3 mm. broad, ± regularly oval, with the dorsum moderately convex. This secretionary layer is secreted slowly from all the upper parts of the body, the glands concerned being scattered. This is not the case in the PSEUDOCOCCINAE, in which the ovisac is formed by secretionary glands in the posterior and marginal portion of the body only. Little or no secretion appears on the ventral surface, so that the leaf or twig forms the floor of the sac; the marginal secretion becomes attached and entirely encloses the ♀. As oviposition proceeds the body shrinks away from the posterior end of the sac which becomes almost filled with ova. At death the dry shrivelled body of the ♀ occupies a small portion at the anterior end.

Prior to secreting the ovisac the ♀ is from 4 to 5 mm. long, and rather more than half as wide. The sides are almost parallel for more than half the length of the body, the posterior end appearing broadly rounded, and the anterior end more pointed. In colour it appears greyish brown with a lighter median, flatly rounded, keel. When seen under a hand-lens, however, it is noticed that the ground-colour of the body is yellowish, and semi-transparent, speckled with black. The anal cleft is short, with the sides closely adjacent. The anal plates are small and brown. The lower surface is slightly concave, greasy-yellowish in colour, the black speckling of the dorsum only showing faintly through at the extreme margins. The stigmatic bands are represented by two short faint white lines on each side.

At a younger stage—when about 2·5 mm. long—the body is red-brown, rugose at the edges, with the median keel not prominent but smoother than the remainder of the body.

The antennae are 8-jointed; range in μ: (1) 31–45, (2) 50–62 (3) 95–108, (4) 54–65, (5) 32–44, (6) 27–34, (7) 27–34, (8) 31–37.

Leg I: coxa 102, femur + trochanter 245, tibia 165, tarsus 85, claw 20μ.

Tarsal digitules moderately long (70μ), slender hairs with their distal ends slightly clubbed. Lower digitules short, broad. Marginal spines short (27μ), truncate. Anal plate about 155μ long. Stigmatic cleft with three comparatively slender spines, laterals about 34μ, median similar but longer (51μ).

Male puparium about 2 mm. long and 1 mm. wide, dark red when containing the insect; white and glassy when empty. The divisions of the test are very prominent, opaque white; the remainder being ± wrinkled and almost hyaline.

Adult ♂♂ were emerging in large numbers when the material was received, 5th April 1916.

Copulation was observed in a number of cases, the ♀ in each case measuring about 4 mm. in length. The body of the male was curved downward admitting the sheath into the cleft of the ♀. During this process the two long waxy filaments of the ♂ stood erect.

The adult ♂ is about 1·0 mm. long, rich red-brown in colour, with two long waxy caudal filaments about half as long again as the head and body combined, without the antennae. The body, legs, and antennae are all red-brown. The head is slightly darker. The scutellum is polished at the edges, with a sunken, matt, central patch. The wings are hyaline, matt, extremely iridescent, with a strong sub-costal, cochineal red band.

When mounted, the following measurements may be taken as an average :—

Head and body, without antennae	1·3 mm.
Antennae	0·847 mm.
Genital spike	0·27 mm.
Wings: length 1·2 mm., width	0·6 mm.
Caudal filaments	2·0 mm.

Habitat: On a native shrub; collected by C. Fuller, Illovo River, Natal, April 1916. On leaves of *Chilianthus oleaceus*, Burch (Loganiaceae), Bloemfontein, O. F. S.; collected by J. C. Faure, April 1916.

Collection Nos.: 127 and 128.

This insect, with the ovisac completed, is similar in appearance to *F. oleae* (Costa) but, according to Signoret's description of that species, the adult has 6-jointed antennae.

222. **Filippia carissae,** sp. n. (Plate i, fig. 236).

This species differs from *F. africana* in the following respects :—

The ovisac is a little larger and generally less compact; often split around the edges (fig. 236). The antennae are more variable, 7 or 8-jointed, range in μ :—

(*a*) 8-jointed: (1) 41–54, (2) 51–54, (3) 102–119, (4) 68, (5) 37–44, (6) 34, (7) 24–27, (8) 34–37; (*b*) a specimen with 7-jointed antennae gave the following measurements :—

i.	54	68	105	122	34	27	41
ii.	41	68	109	68	51	37	68

Leg I: coxa 95, femur + trochanter 240, tibia 204, tarsus 88, claw 20μ.

Anal plate 176μ, rather elongate, with one or two long spines at apex. Margin with a single row of ± plate-like spines, narrow at the base and gradually broadening at the distal ends. Stigmatic clefts somewhat sunken, with three spurs of moderate length.

Habitat: On leaves of *Carissa grandiflora*, A. DC. (Apocynaceae), Natal Coast; common.

Collection No.: 129.

Genus **Conofilippia**, nov.

Female Lecaniid, flat, with well developed legs and antennae; dorsum with numerous sharp spines; margin with slender spines and stigmatic cleft similar to *Lecanium*. At maturity the insect is entirely enclosed in a dense felted sac, which is elevated in the form of a high cowl. Antennae 7-jointed.

Type, *C. subterranea*, sp. n.

223. **Conofilippia subterranea**, sp. n. (Plate iii, fig. 245).

Adult ♀♀ enclosed in conical felted tests on the roots of a native shrub. Test about 6 mm. long, 5 mm. broad and 5 mm. high (figs. 245*a*, *b*).

Adult ♀ flat, about 5·5 mm. long, 4 mm. wide, smooth, glossy, pink to red in colour, brown and wrinkled when dry, on a thick mat of dense powdery material (the floor of the test) which is buff to yellow-brown in colour and dusted with white wax beneath the insect.

In one or two cases the top of the test shows a circular orifice, but this does not appear to be normal and looks as though it had been made for the exit of some Hymenopterous parasite.

Largest ♀, when mounted, about 6 mm. long, and 4·2 mm. wide. Integument clear, with a number of simple glands which are particularly abundant near the margin, and with numerous short (17μ) sharp spines. The margin is thickly set with a compound series of slender spines about 24μ long, which are somewhat curved near their tips. Stigmatic clefts with three blunt spurs, laterals about 27μ, median about 37μ.

Antennae 7-jointed; range in μ: (1) 35–40, (2) 25–34, (3) 40–47, (4) 37–42, (5) 34–44, (6) 17–30, (7) 37–51. In one case joints 6 and 7 were united, forming a segment 64μ long.

Leg I: coxa 102, femur + trochanter 220, tibia 170, tarsus 100, claw 40μ. The junction of the tibia and tarsus is swollen and suddenly narrows towards the distal half of the tarsus.

The anal lobes are rounded, about 230μ long.

Habitat: On roots of native shrub with red stems; collected at De Wildt, Pretoria District, Transvaal, by Claude Fuller, May 1915. The drawings (figs. 245-b) were kindly made from living material by the collector.

Collection No.: 137.

Genus **Ceroplastes,** Gray.

Adult ♀ completely enveloped in a more or less dense covering of wax; no marginal fringe or radiating processes. Sometimes the waxy covering exhibits a variety of arrangement in the form of definite plates or plaques. In other species the covering is uniform in texture and is then most often soft, and contains a large percentage of watery fluid. On removing the wax a caudal prominence is generally visible. Legs and antennae present, well developed.

224. **Ceroplastes bipartitus,** Newst.

Ceroplastes bipartitus, Newst., Bull. Ent. Res. viii, 1, p. 25, 1917.

"Female test. Colour of dried specimens very like pale dirty beeswax. In the young adults the test is broadly oval, somewhat hemispherical and divided into nine plates: three bilateral, one cephalic, one anal and one dorsal, the last-named with a conspicuous dark brown or blackish oval spot, with a central elongated patch of pure white wax; the nuclear spots to the lateral plates are smaller and generally much less conspicuous than the dorsal one. Margin over the stigmatic areas with a pair of laterally compressed and somewhat disc-shaped extensions, each extension carrying on its edge a narrow strip of opaque white wax, the tip of which sometimes reaches the dark nuclear spot of the lateral thoracic plate. In very old examples the test has increased in thickness considerably, but this has been so much damaged in transit as to render it useless for descriptive purposes; however, one can trace the curious marginal extensions, which are somewhat like a narrow-waisted and distorted bobbin, or the toy used in the once popular game 'diabolo.' Average length of young adults, 3 mm.; height 1·6–2 mm.; average length of old adults, 6 mm.; height doubtful.

"Female adult. Denuded of wax, hemispherical; caudal process very long, varying in length from one-half to a little less than one-half the length of the remaining portion of the insect. Submarginal tubercles small, but generally clearly defined; one cephalic and three bilateral, the two over the stigmata slightly more pronounced than the rest. When examined under a high power lens, by transmitted light, these tubercles are seen to be traversed by clear cell-like tracts forming an irregular reticulated pattern. It is reasonable to assume, therefore, that these may be the special set of glands which secrete the nuclear spots in the centre of the plates in the test. Derm relatively thin, but strongly chitinised. Pores minute, separated over a large portion of the dorsum by slightly varying distances equalling the length of one of the short segments of the antennae or two of them together. Stigmatic clefts relatively shallow, but very clearly defined; spines short, obconical, those at the extreme margin very minute and stud-like. Marginal spines or hairs not traceable. Antennae of six segments, the 3rd longer than the last three together. Legs normal. Length of denuded female, inclusive of the caudal process, 4·5–4·6 mm.; length of caudal process, 1·3–1·5 mm.

"Male puparium. Consisting of two distinct parts; the lower half boat-shaped, and of a glassy vesicular texture, as in those typical of the genus *Lecanium*; the upper portion opaque, low, convex, and of a dirty beeswax colour, with nine narrowly rectangular, submarginal patches of snow-white secretion. Anal cleft apparently obsolete. On the emergence of the male the whole of the upper portion falls away, leaving the ventral half attached to the food-plant. The line of cleavage between the upper and lower portion is clearly defined in those puparia from which the imprisoned male has not escaped. Length 1·6 mm.

"South Africa, 1914 (de Charmoy)." (Newstead.)

This species is apparently not represented in the collection of this Division.

225. **Ceroplastes candela,** Ckll. & King.

Ceroplastes candela, Ckll. & King, The Entom. xxxv, p. 113, 1902.

"♀. Long 2⅔, lat. 3½, alt. 4½; dark red-brown, elevated, with vertical sides. Caudal horn a prominent stout spine, hardly ½ mm. long, placed nearer the top of the scale than the base. Dorsum smooth and shining, with only a very small central raised line. Sides of insects with vertical stripes of dense secretion; no wax, except that composing these stripes, between the insects, which are densely crowded together, their vertical sides contiguous. They rest on a thin substratum of wax, and are covered above with yellowish-white wax, about 1 mm. thick. The outlines of the insects are vaguely marked on the surface of the covering wax by a brownish stain. The wax, with the insects beneath, surrounds the twig as the wax does the wick of a candle; the whole mass is about 20 mm. diameter, that of the twig being about 5 mm.

"Mr. King found the antennae to measure thus in μ:—

Joints	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Length	56	68	56	60	28	32	40
Breadth.. ..	64	48	40	32	28	28	24

"Found by Mr. Fuller at Richmond, Natal. The nearest ally is an undescribed species from Paraguay, collected by Professor Bruner." (Ckll. & King).

This species is not represented in the collection.

226. **Ceroplastes combreti,** sp. n.

Test of ♀ about 3 mm. long, broad and high, conical, with the anterior side a little more precipitous than the posterior, which is somewhat excavate above. There are no plaques, but the whole body of wax is arranged in ± distinct columns, three on each side. The apex is blunt, bearing an opaque white ridge surrounded by six opaque white spots—the tops of the columns. Between the two most prominent lateral ridges are the distinct white stigmatic bands which extend from the base to the crown. The colour, when fresh, is bright rose-red with darker transverse marks.

The antennae are 8-jointed; range in μ: (1) 37–44, (2) 56–61, (3) 34–48, (4) 27, (5) 37–41, (6) 20–24, (7) 17–24, (8) 37–41.

Leg I: coxa 75, femur + trochanter 180, tibia 129, tarsus 85, claw 20μ.

Anal plates ± semicircular, about 160μ long and 85μ broad. The derm is thin and transparent, with numerous small, scattered, simple glands, from some of which short, tubular projections arise. Stigmatic clefts with large numbers of very small, roundly conical, thimble-shaped spines.

The distinct, long, opaque white lines, the reddish colour, soft wax, etc., suggest *quadrilineatus* of Newstead, but this latter species has 6-jointed antennae and is obviously quite distinct by other characters of the test.

Habitat: On stems of *Combretum* sp., De Wildt, Pretoria District; collected by Claude Fuller, July 1918.

Collection No.: 317.

227. **Ceroplastes destructor,** Newst.

Ceroplastes ceriferus (Anderson) Newstead, Bull. Ent. Res. i, pp. 66, 195, 1910.

Ceroplastes destructor, Bull. Ent. Res. viii, p. 26, 1917.

"Female test. White, creamy white or dirty white; exceedingly soft and containing an excess of moisture. Form irregular, with large but ill-defined gibbose protuberances; sides usually with two narrow opaque lines of secretion from the stigmatic clefts. No trace of lateral plates. Length, 4–8 mm.

"Female, adult. More or less hemispherical, with the sides often slightly compressed; caudal process long; integument castaneous and highly chitinised, smooth and shining, and without fovea or lateral tubercles. Antennae of six segments, the 3rd being as long as the 4th, 5th, and 6th together; the last three segments with stiff and bluntly pointed, spinose hairs. Legs small; hind femora very short and often distinctly incrassate; hind tarsi equal in length to the tibiae, or sometimes slightly longer. Claw very short; lower digitules very long and stout; upper digitules normal. Stigmatic clefts well defined, but relatively small; stigmatic spines very small and pointed, bases not constricted; basal attachment (disc) very large. Caudal process (after maceration) transparent and somewhat flexible; sides with an irregular double row of short spinose hairs, and in addition to these there are two pairs of longer hairs (one pair of which is twice the length of the others) slightly ventral to the row of short ones and towards the distal extremity. Anal lobes short and highly chitinised. Dorsal pores very small, rather widely separated. Ventral integument opposite the caudal process, with rather extensive groups of circular pores, many of which, in well cleared specimens, are linked together with lines of dark chitin. Length 4–7 mm." (Newstead.)

Habitat: On custard apple and avocado, Nelspruit, Transvaal; collected by D. Gunn, September 1915 (Coll. No. 93). On syringa (*Melia azedarach*), Bechuanaland, October 1918 (*Coll. No.* 336).

Collection Nos.: 93 and 336.

228. **Ceroplastes egbarum,** Ckll.

Ceroplastes egbarum, Ckll. The Entom. xxxii, p. 127, 1899.

Ceroplastes cristatus, Green, Ann. Mag. N.H. (7) iv, p. 190, 1899.

Professor Cockerell's description is as follows:—

"Waxy female scales often crowded on the twigs, two or more coalescing; about 11 mm. long, 10 broad, and 6 high, the wax extremely thick, not at all divided into plates, snow-white, here and there with a suffused pinkish stain.

" ♀. Denuded of wax 5½–7 mm. long, 4 broad, 2½–3 high, very dark, with a dorsal hump but no lateral humps; anal horn a mere mammiform prominence. Boiled in caustic soda the denuded females give a purple colour, which on dilution with water appears pink, and soon forms a flocculent pink precipitate. On adding nitric acid a flocculent white precipitate appears, but the pink precipitate is not altered. Skin after boiling remains yellowish brown, chitinous, with scattered minute gland-dots. Stigmatic areas with numerous crowded gland-spots, and many short and rather thick simple spines, but no capitate spines. Legs dark brown, the parts measuring thus in μ: Coxa, 120; femur with trochanter, 180; tibia, 128; tarsus with claw, 96 to 114. Tarsal digitules 60μ, slender, with a small knob. Claw digitules with very large round knobs, extending about 15μ beyond tip of claw. Antennae apparently only 6-segmented, but the segmentation towards the end very obscure. The segments measure in μ: (1) 45; (2) 60–69; (3) 66–78; (4) 51; (5) 69; (6) 72. Segment 5 has a deep notch which makes it look as if divided into two.

" Young larvae under female about 430μ long and 230 broad, tinged with a warm reddish colour. Male scales small, elongate, and glassy."

In the description of *C. africanum* var. *cristatus* Green states that specimens from Natal differ from *africanum* (i.e., *mimosae*) only in the presence of a small dorsal crest corresponding to the position of the central scar. They were, however, larger, being 12 mm. in diameter. This would seem to indicate, moreover, that the antennae may be 6, 7, or 8-jointed.

Habitat: On *Acacia*, Natal.

Collection No.: 87.

229. **Ceroplastes egbarum fulleri,** T. & W. Ckll.

Ceroplastes egbarum subsp. *fulleri*, T. & W. Ckll., The Entom. xxxv, p. 113, 1902.

Adult ♀, with waxy covering about 14 mm. long, 12·5 mm. wide and 7 mm. high. Waxy covering regularly domed with a slight depression in centre. Margins widely crenulate, with usually two conical deflected waxy masses which clasp the stem. Stigmatic cleft waxy appendages conspicuous, snow-white, long and slender. There are two of these on each side, usually 3 to 4·5 mm. long, about 1 mm. thick at attachment to waxy covering, but gradually tapering to their extremities. They usually lie closely pressed to the stem of the host plant. The colour of the waxy covering is whitish to coral, pink, with distinct brown patches on the intermediate area and lighter zones around the dome.

Female, denuded of wax, 7 mm. long, 5·5 mm. broad and 4 mm. high. Colour coral pink, more yellowish than the darker coloured wax. The extreme frontal margin, the stigmatic clefts and the caudal projection are dark castaneous and shiny. In older specimens, after oviposition, the integument becomes brown.

The venter is flat or concave with the median zone sunken and segmented. The 4 white stigmatic bands extend inwards to this sunken area. The lateral margins are slightly excavate, the upper edge of the excavation being formed by seven depressed conical projections from the intermediate area. The anterior of these extends forward until nearly level with the front edge of the rounded anterior lobe.

The three lateral projections of each side are shorter and more bluntly pointed. The depressed area which separates the central cone from the intermediate area is coarsely punctate. The central cone is regular, elongate, oval at the base and roundly pointed at the apex. There is no sunken area in the centre.

The caudal projection is exceptionally short, bluntly conical, projecting at an angle of about 45° with the ventral surface.

Antennae 8-jointed; range in μ: (1) 44–51, (2) 48. (3) 58–68, (4) 34–37, (5) 27–34, (6) 20–24, (7) 20–24, (8) 37–48.

Integument clear, hyaline, except for the extreme margin, marginal expansions and caudal prominence, which are densely chitinised. The anterior margin is broadly rounded with a distinct parallel-sided chitinous band. Lateral margins with two almost circular expansions on each side. These are much larger than those found in *mimosae*.

Habitat: On " monkey rope," Natal coast, Umbilo and Equeefa Rivers.

Collection No.: 88a.

230. **Ceroplastes eucleae,** sp. n. (Plate ii, fig. 239).

Adult ♀ tests sometimes single on stem, often aggregated in dense masses. Test of adult ♀ about 6 mm. long, 5 mm. wide and 5·5 mm. high, without plaques but with the lower portion forming a wrinkled fold at the base of a highly conical dome. The colour is a delicate green, when alive, with the stigmatic bands conspicuous (fig. 239); when dry, it is semi-transparent, greenish yellow, with two white thin streaks on each side just above the stigmatic clefts. The central dome is pointed, without any central pit or depression, and is distinctly separated from the lower portion of the test by a groove. There is no indication of a caudal prominence on the test.

Female, denuded of wax, smooth, regularly domed, without caudal prominence, chitin pale brown and moderately thin; portion surrounding the anal plates deep castaneous. Caudal prominence rudimentary, indicated by deeper coloured chitin. When cleared, the derm is moderately chitinous. That of the dorsum is very finely rugose with very scattered small, transparent spots. The denser, marginal folds have in addition a few larger holes.

Antennae 6-jointed; range in μ: (1) 24–30, (2) 37–40, (3) 91, (4) 17–24, (5) 24–27, (6) 40.

The legs are moderately developed, normal.

Stigmatic clefts with a series of short, conical, thimble-shaped spines, which extend in a single row for some distance along the margin on either side of the cleft, where they compose a double row. About the middle of the group is a large spine, about twice as large as the others. Within the double row is a collection of small simple glands like the circumgenital glands of the DIASPINAE.

Habitat: On stems of several native shrubs, including *Euclea* sp., *Ochna* sp. ?, *Pavetta* sp. ?, etc., Pretoria; collected by Miss E. Impey, January 1915.

Collection Nos.: 90 and 342.

231. **Ceroplastes longicauda,** sp. n.

Adult ♀ covered with a very thick layer of soft, white wax forming a test like a large *ceriferus* specimen, i.e., a little more elevated than *egbarum*. Largest specimen seen measured 18 mm. long, 11 mm. wide and 12 mm. high; marginal area prominent, forming a wide fold at the base of the central dome. The waxy appendages from the stigmatic clefts only project slightly from the main mass of the fold.

Adult ♀, denuded of wax, bright brown in colour, about 5 mm. long without caudal process, which alone measures 3·5 mm. The body is ± star-shaped with three short, lateral pointed spurs and one anterior. These are sharper and more prominent than those of *ceriferus*. The dorsum is very convex, rising with straight sides to an acute point. The caudal process is exceedingly long, two thirds the length of body, piceous, slightly tapering, and extends in a horizontal direction, i.e., flat along the twig.

Cleared and mounted, the insect is remarkable for the broad oval, thin, transparent body with a very long dense black tail. The integument is uniformly hyaline, without chitinous marginal discs such as those found in *fulleri*, etc. In stained material the integument of the dorsum illustrates a strange segmentation ± in plates, 5 elongate transverse median ones and shorter laterals.

The antennae are 7 or 8-jointed, e.g., (1) 40, (2) 37, (3) 40, (4) 47, (5) 68, (6) 30, (7) 27, (8) 37μ; or (1) 23, (2) 34, (3) 40, (4) 88 (with pseudarticulation), (5) 27, (6) 27, (7) 37μ.

Stigmatic cleft thin, hyaline, with a patch of scattered, short, thimble-shaped spines and, within this, a large group of simple glands similar to the circumgenital glands of the DIASPINAE.

Legs comparatively short, otherwise normal.

Habitat: On stems of native shrub; collected by C. Fuller, Natal Coast, July 1915.

Collection No.: 334.

This species is very similar in many respects to *C. ceriferus* but may be readily separated by the larger size of the adult ♀ test, the comparatively longer caudal process and the 7 or 8-jointed antennae. *C. ceriferus* has antennae 5 or 6-jointed, usually 6.

232. **Ceroplastes mimosae,** Sign. (Plate ii, fig. 241).

Ceroplastes mimosae, Sign., Ann. Soc. Ent. Fr. (5) ii, p. 46, 1872.

Ceroplastes africanus, Green, Ann. Mag. N. H. (7) iv, p. 188, 1899.

"Insects crowded on the stems of the plant, so much so that the waxy covering of adjacent individuals becomes more or less confluent and the normal form of the test is difficult to determine. The tests appear as rounded masses of cream-coloured wax, each with a more or less distinct nipple-like prominence at the apex bearing a small spot of whiter substance.

"The usual opaque white bands from the spiracular regions are present, but very inconspicuous, scarcely extending beyond the margin. In some specimens a series

of impressed arches on the sides of the test marks the position of the marginal plates. The waxy coating being thinner on the impressed parts, the arches appear darker, the colour of the body of the insect showing through the covering-matter. An isolated test averages 7·75 mm. long, 6·50 mm. broad, 5·75 mm. high.

"Female, denuded of wax, reddish brown to dark brown, the whole surface strongly chitinised; irregularly globose; apex often with an oblong scar corresponding with the position of the early larval pellicle, but which becomes almost obliterated in the oldest examples. In the early adult the median is separated from the marginal area by a more or less distinct furrow, which is particularly marked where it meets the anal tubercle. In the older examples only this hinder part of the furrow remains. Cephalic area constricted off from the globose body, forming a trowel-shaped projection in front. Spiracular clefts deeply indented, thickly set with small conical spines, not constricted at the base. Marginal hairs very small, few and inconspicuous. Anal scales minute, inner edge straight, base and outer edge together forming a semicircle. Anal tubercle blackish, directed upwards. Derm with numerous glandular pores, which are more distinct on the darker marginal area. Antennae with either 7 or 8-joints. It is difficult to say which is the normal number, as the two varieties are about equally represented in the series under examination. With the 8-jointed form the formula runs:—3, (1, 2), 8, 4, 5, (6, 7). When there are seven joints only the formula is 3, (1, 2, 4), 7, (5, 6). In this latter case there is a tendency for the fourth joint to separate into two, and there is always a more or less distinct false joint in the terminal segment. Legs well developed; tarsus more than half length of tibia. Foot with 4 digitules, the unguals broadly spatulate, the tarsals fine knobbed hairs.

"Length of fully developed female 5·50 mm., breadth 5·0 mm., height 4·25 mm.

"The male insect is unknown in any stage." (Green.)

The material I have examined has a characteristic odour and has uniformly 8-jointed antennae, with the following range in μ: (1) 27–34, (2) 41–48, (3) 58–68, (4) 27–41, (5) 17–37, (6) 17–24, (7) 20–24, (8) 34–37.

Habitat: On *Acacia karroo*, Cape Colony; common but local.

Collection No.: 85.

233. **Ceroplastes myricae** (Linn.).

Coccus myricae, Linn., Syst. Nat. Ed. xii, i, p. 741, 1766.

Columnea myricae, Targ., Catalogue, p. 35, 1869.

Ceroplastes myricae, Sign., Ann. Soc. Ent. Fr. (5) ii, p. 39, 1872.

"Habitat ad Cap. B. Spei, in Myrica quercifolia.

"Magnitudo pisi minoris, semi-ovatus secundum perpendiculum, pallide incarnatus, vertice obtuse acuminatus cum poro tenuissimo, postice supra marginem etiam porus est, margo cartilagineus, crassior albus, utrinque circiter septem torutis protuberans.

"Dans Olivier, Encyclopédie, VI, 96, 8, nous trouvons une description presque identique: la femelle est presque de la grandeur d'un petit pois, le corps est d'une couleur rouge pale et de forme demi-ovale, le vertex est elevé et percé d'un petit point, tout le bord est cartilagineux, épais, blanchâtre, marqué de chaque côté de petits cordons élevés.

"Ce sont ces sept cordons élevés qui, spécifiant bien l'espèce, nous empêchent de l'attribuer aux nombreux individus que nous possédons et decrivons sous le nom de *C. Vinsonii*." (Sign.)

Myrica quercifolia, Linn. (Myricaceae) is a near relative of the waxberry plant which is common on the Cape Flats. Mr. C. W. Mally, the Entomologist for the Cape Province, has recently kindly examined a large number of plants in an endeavour to re-discover this species of *Ceroplastes*, but as yet without success.

234. **Ceroplastes pallidus,** sp. n.

Test of adult ♀ to 8·5 mm. long, 6 mm. broad and 4·5 mm. high; very much like a large *C. rusci* in form, with 8 lateral plaques and median dome. The lateral plaques, however, are without "nuclei" and are a little more perpendicular. In old specimens the waxy covering is pale, semi-transparent, yellowish, or having an indistinct greenish tint. The central dome is moderately elevated, somewhat tapering, slightly glossy, with longitudinal and concentric striae. The central "nucleus" is elongate, glossy and a little darker in colour. Stigmatic clefts indicated by small white dots.

When cleared and mounted the integument is all thin and hyaline, without anterior or marginal thickenings and with only a small area surrounding the anal lobes chitinised.

Stigmatic clefts shallow, not chitinised, with short, conical, pointed spines which are in a single row for a short distance on each side, but broaden out to form a small triangular patch opposite the spiracle; at no point, however, are there more than 5 rows. Within this series is a compact group of simple glands like the circumgenital glands of the DIASPINAE and also a few smaller glands and short simple hairs. The remainder of the margin has a scattered, single row of short, slender, sharply pointed spines.

The antennae are 8-jointed; range in μ: (1) 37–44, (2) 37–47, (3) 44–52, (4) 34–44, (5) 51–56, (6) 27–32, (7) 27–34, (8) 35–47.

Legs well developed, normal; tibia long, with a constriction at about the middle.

The caudal tubercle is comparatively small, a mere plate with the chitin appearing ± streaky and somewhat perforate.

Habitat: On fig, Church Square, Pretoria.

Collection No.: 102.

235. **Ceroplastes quadrilineatus,** Newst., var. **simplex,** nov.

Adult ♀♀ clustered in large masses on the twigs of the host plant. ♀ test about 5 mm. long, 4·5 mm. broad and 3 mm. high, very dark in colour, almost black, with the thinner parts of the wax appearing reddish. Marginal fold corrugated, lighter and more transparent in colour than the central dome, with two very distinct lines of opaque white on each side. The central portion is comparatively flat and truncate, separated from the marginal fold by a deep furrow in dry material, with the apex hollowed into a shallow cup containing an opaque white ridge. The ridge of this cup-like depression is not regular but consists of an anterior transverse ridge and two posterior lateral spurs, and the floor usually slopes gently forward. The

anal opening to the test is surrounded by a distinct circular ring which is itself sunken in a deep depression with broadly rounded sides. In dry specimens the whole waxy material is roughened, hard and very brittle. The pair of larger divergent pyriform bodies referred to in the description of *quadrilineatus* are not present.

When cleared of the waxy covering the insect is of a characteristic form, with the dorsum uniformly rounded and smooth and the marginal area produced in a series of broadly rounded bead-like lobes. The caudal prominence is extremely rudimentary, appearing as a flatly rounded hump, black in contrast with the deep red brown of the remainder of the insect. The integument, when cleared, is dense and is pitted like that of many species of *Saissetia*. The stigmatic spines are in an elongate row around the shallow cleft, the series becoming double in the centre.

The antennae are 6-jointed, three being very long and variable, e.g. :—(1) 27, (2) 37–40, (3) 88–119, (4) 20, (5) 27, (6) 44–51μ.

Legs long, normal. Chitin of caudal protuberance appears as though bossed with a honey-comb pattern.

Habitat: On stems of *Rhus* sp. (probably *R. viminalis*), Victoria West, C.P.; collected by Mr. van Heerden, October 1915.

Collection No.: 346.

236. **Ceroplastes rusci** (Linn.)

Coccus rusci, Linn., Syst. Nat. Ed. x, i, p. 456, 1758.

Coccus caricae, Bern., Mem. Acad. Marseille, p. 89, 1773.

Coccus artemisiae, Rossi, Mant. Ins. ii, pp. 56, 514, 1794.

Calypticus radiatus, Costa, Faun. Reg. Nap. Cocc., p. 12, 1835.

Calypticus testudineus, Costa, Faun. Reg. Nap. Cocc., p. 12, 1835.

Calypticus hydatis, Costa, Faun. Reg. Nap. Cocc., p. 14, 1835.

Columnea testudinata, Targ., Atti dei Georgofili, n.s. xiii, p. 31, 1866.

Coccus hydatis, Targ., Studii sul. Cocc., p. 12, 1857.

Columnea testudiniformis, Targ., Studii sul. Cocc., pp. 8, 11, 12, 1867.

Chermes caricae, Bdv., Ent. Hort., p. 320, 1867.

Ceroplastes rusci, Sign., Ann. Soc. Ent. Fr. (5) ii, p. 35, 1872.

Lecanium artemisiae, Sign., Ann. Soc. Ent. Fr. (5) ii, p. 37, 1872.

Adult ♀. Test about 7·5 mm. long, 5·2 mm. broad and 5 mm. high, regularly domed, rounded in front, rather excavate behind. Colour greasy white, suffused with purplish red. Dorsal dome and margins of plaques lined with greenish grey lines; anal pore and middles of plaques of same colour. Stigmatic bands, 2 on each side, pure white, broad at stem and tapering inwards. Middle of dorsum with a depression in which there is an elongate, glossy white prominence similar to those in centres of plaques, but longer.

Antennae 6-jointed; range in μ: (1) 34–40, (2) 37–40, (3) 114–120, (4) 17–24, (5) 20–27, (6) 44–57.

Leg II: coxa 102; femur + trochanter 170; tibia 120; tarsus 85; claw 20μ.

Margin of sides of body with a single row of small thimble-like spines; amongst these are mixed a few simple spines. Stigmatic clefts very shallow, not chitinised,

with a few additional spines like those of the marginal series and a small group of simple glands like the circumgenital glands of the DIASPINAE. Anal plate heavily chitinised, with scattered perforations.

Habitat: On stems of quince, Stellenbosch, C.P.; collected by F. W. Pettey, July 1916.

Collection No.: 91.

237. **Ceroplastes tachardiaformis,** sp. n.

Adult ♀ tests aggregated in huge masses on stems of the host-plant, often completely covering the stems for a distance of several inches.

♀ test *Tachardia*-like, globular, slightly flattened above, hard, thin, brittle, almost transparent resinous brown, due to the colour of the insect within; without protuberances but with a slight apical depression containing the opaque white larval exuvia.

Adult ♀, denuded of wax, moderately dense, globular, smooth and shiny. Caudal protuberance short, very dense, surrounded by a coarsely perforated plate.

Antennae 6-jointed, e.g. (1) 34, (2) 27, (3) 74, (4) 20, (5) 17, (6) 30μ.

Legs short, e.g., coxa 50, femur + trochanter 110, tibia 78, tarsus 50μ.

Integument moderately dense, appearing, under the high power, finely rugose, with numerous, widely scattered, small, transparent pores. Stigmatic clefts almost obsolete, indicated by a small group (8 or 10) of short obconical spines and a few simple glands.

Habitat: On rhenosterbosch (*Elytropappus rhinocerotis*, Less.); collected by Messrs. Watermeyer Bros., Aberdeen, C.P., November 1915.

Collection No.: 94.

238. **Ceroplastes zonatus,** Newst.

Ceroplastes zonatus, Newstead, Bull. Ent. Res. viii, p. 32, 1917.

"Female test. Broadly ovate in outline, highly convex; marginal plates very faintly indicated, but apparently without nuclear spots; dorsal plate very large, with a central nuclear spot of white wax; cephalic margin slightly clypeate; lateral margins in very old examples with a pronounced foot-like extension from each of the stigmata, from which there extends a thick white waxen appendage. In the younger forms the foot-like extension is wanting, but the white waxen appendages are present and always porrected. Colour creamy white, suffused with very pale brown; dorsal plate surrounded by a shaded wavy zone of dark brown and brownish black, with here and there a suffused patch of dull flesh-colour. In very old examples the zone of colour extends to the margins and is of a shining madder-brown to piceous colour. On the removal of the outer surface of the test with chloroform, it is seen to be divided into seven areas by pale orange-coloured lines; a central polygonal area, corresponding to the area occupied by the dorsal plate, from the angles of which radiate to the margin single lines marking off the areas of the lateral and cephalic plates.

"Female adult (denuded of the test). Ovate; cephalic margin clypeate; dorsum low and wrinkled; two large, bilateral, submarginal extensions, both longitudinally striated; the space between these extensions of the body-wall and

the margin markedly constricted. Dorsum with a large keel-like process. Caudal process very short and conical. Stigmatic clefts deep. Antennae of eight segments; the articulations relatively very broad; 3rd about equal in length to the 7th and 8th together; a very long hair on the 2nd and 5th, and a slightly shorter one on the 8th; there are two spines on the 8th and one on the 7th. Legs normal. Stigmatic spines covering a large and somewhat pyriform area, the length of which is nearly equal to twice the length of the antennae; the spines, with the exception of a small group near the stigmata, are obconical and the space between them with bands of dark granular bodies, which collectively form a polygonal reticulation; the small proximal group of spines are longer than the others and pointed. No trace of marginal spines. Derm thin and transparent after maceration; rather thickly set with minute pores and minute scattered spines. Caudal process surrounded by a porose zone of brown chitin. Length 3·9–4·6 mm." (Newstead).

The above description does not refer to the mature female forms which attain, with the waxy test, 14 mm. long, 12 mm. broad and 8 mm. high. The colours remain the same except that the lighter parts become yellowish.

When mature the denuded female is densely chitinous, brownish black, with the dorsum smooth, shining. In boiling KOH it stains the liquid deep purplish brown. The antennae are sometimes 7-jointed with joint 4 very long, obviously 4 + 5 of the 8-jointed form.

Habitat: On *Acacia* sp., Pretoria, November 1914.

Collection No.: 344.

Genus **Inglisia,** Mask.

Adult female more or less conical, covered above by a glassy shield which is divided into plates and striated with rows of air cells. Legs and antennae well developed.

239. **Inglisia elytropappi,** sp. n.

Test of adult ♀ small, 1·6–2 mm. long, 1·2 mm. wide and high, like a small bivalve shell with its hinge uppermost standing on the stem. It is very like a small *zizyphi* test but paler in colour, with the upper angles of the two halves smooth instead of tuberculate. The colour is white to pale buff, shiny, often pearly, with the vertical striae conspicuous.

♀, with the test removed, shiny dark brown, of the same general shape as the test, with the apex depressed between two rounded lateral humps.

Cleared and mounted the body is hyaline. The margin has a close-set row of short conical spines with broad bases and moderately sharp points. The stigmatic clefts are obsolete, but their presence is indicated in the marginal row of spines by the addition of a single, slightly longer spine with a narrower base.

The antennae are rudimentary, appearing in varied forms with very indistinct segmentation ranging from 4 to 7-jointed. When 7-jointed the segments are generally very short—mere rings. The measurement of such an antenna gave the following in μ:—(1) 17, (2) 6, (3) 17, (4) 6, (5) 10, (6) 6, (7) 6.

Legs rudimentary, appearing as though composed of three, almost equal, cylindrical segments with a minute claw. The total length varies between 70 and 90μ.

Habitat: On the thinnest twigs of rhenosterbosch (*Elytropappus rhinocerotis*, Less.), Groot Drakenstein, Somerset West and Cape Flats, C.P. (Cape Coll. No. 1244). The stems of the host-plant are thickly covered with "sooty" fungus, apparently grown on secretion from the numerous specimens present.

Collection No.: 100.

240. **Inglisia geranii,** sp. n. (Plate iv, fig. 249).

Insects congregated on the main stems at or near the nodes. Adult insect, with test, about 2·5 mm. long and 1·3 mm. broad at the base, brown, with the air spaces of the test almost colourless and appearing as transverse lines radiating from the centre of each half of the test. The test is composed of two similar halves, each of which simulates a shell or tortoise-shell, with their apices widely separated. The median line at the point of union of the two is almost flat, very little depressed. The test easily flakes away from old specimens and is then white, almost hyaline.

The antennae are 7 or 8-jointed; range in μ:—7-jointed: (1) 24–31, (2) 14–20, (3) 41–48, (4) 17–20, (5) 14–20, (6) 14–17, (7) 20–24; 8-jointed: (1) 24, (2) 17, (3) 31–34, (4) 14, (5) 14–17, (6) 14–17, (7) 17, (8) 24.

Leg I: coxa 68; femur + trochanter 136; tibia 109; tarsus 85μ. The trochanter has a long (90μ) spine. The upper digitules are long and slender, hardly perceptibly clubbed; lower digitules comparatively short and slender.

Anal plate about 115μ long, with 2 or 3 stout spines. Margin with a single row of sharp pointed spines of varying lengths; these are all broad at the base and taper rapidly to the point. Stigmatic cleft with a single spine a little longer than the longest of the marginal series and a little less tapering.

Habitat: On geranium, King Williamstown, C.P.; collected by A. Kelly, March 1916. Fresh material sent by Mr. J. Hobson, King Williamstown, May 1916.

Collection No.: 99.

This species is remarkably close to *Inglisia theobromae*, Newst., which was described on cacao from Uganda, but it is smaller, and joint 3 of the antennae is apparently always longer than 4. It is also somewhat like *I. bivalvata*, Green, but the dorsal shield, formed by the inner sides of the two halves of the test, is wider and more oval.

241. **Inglisia zizyphi,** sp. n.

Test of adult ♀ shaped like a small bivalve shell, standing erect, with the two halves separated by a conspicuous furrow, and the hinge uppermost, represented by two small, rugose "crowns" of the two halves. The lower margins, which rest on the stem, are surrounded by a slight fringe of fine glassy filaments. The test is pale horn-colour, with the distinct vertical striae appearing slightly iridescent. Length 2 to 3 mm.; width 1·5 to 2 mm.; height about 2 mm.

Adult ♀, with the waxy test flaked off, red-brown, of the same shape as the test but with the dorsum shiny and wrinkled.

Cleared and mounted the integument is thin and hyaline. Margin with a dense series of stout conical spines, so closely set that the row appears, in places, double. The derm is clear except for a double row of large simple glands extending along the median line from the anal plates to the middle of the dorsum.

Antennae 5 or 6-jointed, the individual segments badly defined even in stained preparations; range in μ:—5-jointed: (1) 24, (2) 14, (3) 41–51, (4) 24–34, (5) 24–27; 6-jointed: (1) 20–24, (2) 10–14, (3) 48–51, (4) 10–17, (5) 14, (6) 20–24.

Legs short but normal, e.g., coxa 41; femur + trochanter 102; tibia 75; tarsus 58; claw 17μ. Anal plates about 90μ long, each with two fairly stout spines about 40μ long. Stigmatic clefts obsolete.

Larva about 390μ long; antennae 6-jointed; caudal setae very long (170μ).

Habitat: On *Zizyphus* sp., Pretoria; collected by the writer, December 1914.

Collection No.: 101.

This species is very close to *I. conchiformis*, Newstead, but is smaller and has an antennae of 5 or 6 segments instead of 7. I thought at first that I was dealing with young individuals of Newstead's species but mounted specimens contain well developed embryonic larvae.

Genus **Cryptinglisia**, Ckll.

"A Lecaniine Coccid having a glassy covering containing air-spaces, and retaining the legs and antennae (7 or 8 joints) in the adult. Living in galls on the roots of *Vitis*. Differs from *Inglisia* in its mode of life; in the glassy scale not being divided, tortoise-like, into plates; and in the air-cells running together, forming long air-spaces. Larva ordinary, with six large bristles on the cephalic margin. Male unknown." (Ckll.)

242. **Cryptinglisia lounsburyi**, Ckll.

Cryptinglisia lounsburyi, Ckll., The Entom. xxxiii, p. 173, 1900.

Cryptinglisia lounsburyi, Lounsb., Rep. Ent. Cape Good Hope, p. 54, 1900.

"Adult female about 2½ mm. long, soft, shiny, very dark brown, covered with a semi-transparent, brittle, glassy scale. Skin transparent and colourless on boiling in KOH; mouth-parts moderate, rostral loop not very long; margin with a row of simple spines, brownish, about 24μ long, placed close together; anal lobes ordinary, about 160μ long, yellowish brown, surrounded basally by a large, thick, dark brown, chitinous plate, more or less semilunar in form, with the ends produced; a row of small round glands in the middle line from one end of the body to the other, but best developed posteriorly; antennae and legs pale; legs ordinary, femur plus trochanter about 120, tibia about 96, tarsus about 78, claw about 20μ; claw-digitules about as long as claw, with large knobs; tarsal digitules long, with distinct knobs. Antennae 7 or 8-jointed, having three types, thus: (1) 7-jointed with a short 3, all the joints subequal, 21 to 30μ; (2) 7-jointed with a long 3, which is about 41μ long; (3) 8-jointed, with 2 quite short, and 3 and 4 each about 30μ long. The terminal joint is always short, 21 to 26μ.

"These insects occur underground on the roots of grape vines, living in galls which are more or less globular, 4 to 5 mm. diameter, dark, rough and often nodulose on the outside, often aggregated together in numbers, or even coalescing, so that the root presents a nodulose thickening 6 or 7 mm. in diameter and over 20 mm. long. On breaking open the galls, which are quite hard, one finds a cavity containing the Coccid. Small stones are frequently embedded in the sides of the galls.

"*Hab.* Constantia, Cape Colony, at the roots of Stein and Reisling grapes (*Vitis vinifera*). Mr. Chas. P. Lounsbury, sending the specimens, says; 'None were observed more than eight or nine inches from the surface, and all were on fibrous roots. As you will observe from the specimens, they are somewhat gregarious; ofttimes one or two rootlets will be quite covered, while all the others are free. Most of the infested vines were backward in growth—some almost dead; but their condition, I think, is due to other causes than the attack of the insect. Some apparently healthy vines were noticed to be affected." (Ckll.)

This species has not been re-discovered.

Collection No.: 105.

Genus **Parafairmairea,** Ckll.

Female scale divided by a longitudinal, median suture into two halves, each with minute grooves radiating from its apex but not striated with air cells. Legs and antennae well developed, the latter 7 or 8-jointed.

243. **Parafairmairea patellaeformis,** sp.n. (Plate iv, fig. 250).

Adult ♀ dull brown, 9 mm. long and 5 mm. broad, covered above by a stout shield which is divided longitudinally into two halves. This shield has the wavy lines and exact appearance of one of the common shells of the more elevated "Patella" type.

With the covering removed the insect is glossy brown with wrinkles and ridges radiating from a two-fold dorsal peak to the margin.

Antennae 7 or 8-jointed; range in μ:—

I.	II.	III.	IV.	V.	VI.	VII.	VIII.
20–31	20–24	41–68	34–41	20–27	14–24	20–34	–
20–31	20–24	44	17–34	27–34	17–20	14–20	24–34

Leg 1: coxa 88–102; femur + trochanter 187–238; tibia 160; tarsus 90; claw approximately 20μ.

Anal plate about 160μ long. The integument is thin and hyaline, without conspicuous hairs or glands. The margin has a single row of short, conical spines of the *Inglisia* type, amongst which are intermingled, at intervals, smaller spines of a thinner type. The stigmatic clefts are obsolete, merely indicated by a scant series of small circular, simple glands extending inwards from the margin towards the spiracle.

Remarks: This is the third *Parafairmairea* to be described. The other two were described on grass, one from France and the other from Surrey, England.

Habitat: On stems of *Acacia karroo*; collected by A. E. Kelly at Port Alfred, C. P., March 1915.

Collection No.: 98.

Genus **Ceroplastodes,** Ckll.

Female scale convex, but not cone-shaped ; not divided into two halves, nor into distinct plates, but rough or beset with protuberances. ♀ with antennae 7- or 8-jointed.

244. **Ceroplastodes bituberculatus,** sp.n. (Plate iv, fig. 251).

Test of adult ♀ about 4·5 mm. long and 3 mm. broad and high, white, with two prominent humps, one at each end of the median ridge ; margin with a distinct white fringe. The test indicates the anal cleft and has a small prominence over the anal lobes.

Male scale dull white, with the median area denser, about 1·5 mm. long, divided into plates in the normal manner.

Adult ♀ with the waxy covering removed, dark brown, of similar shape to the test. Integument, when mounted, clear, hyaline, without glands or hairs. Margin with a single, close-set row of tubular spines somewhat of the *Inglisia* type but more linear and truncate. Stigmatic clefts obsolete but indicated in the marginal series of spines by the addition of three stigmatic spines ; laterals slender, a little longer than the marginal spines ; median stout, two and a quarter times as long as laterals (116μ).

Legs and antennae long, well developed. Antennae 8-jointed ; range in μ: (1) 27–34, (2) 20–34, (3) 63–68, (4) 31-34, (5) 37–48, (6) 17–20, (7) 17–20, (8) 34-41 (from 5 antennae).

Leg I : coxa 78 ; femur + trochanter 176 ; tibia 120 ; tarsus 90 ; claw 24μ. Tarsal digitules very long, slender, clubbed ; claw-digitules comparatively slender.

Anal plates about 145μ long, apex with 4 very stout blunt spurs.

Habitat : On stems of native shrub, Somerset West, C.P. ; collected by T. F. Dreyer, November 1906. Also at Stellenbosch (Fuller).

Collection No. : 327.

Genus **Idiosaissetia,** nov.

Adult ♀ secreting a thin brittle covering of waxy material not divided into plates or two halves, and without air cells. Legs and antennae present but rudimentary. Anal cleft not median but to one side.

Type, *I. peringueyi*, sp. n.

245. **Idiosaissetia peringueyi,** sp. n.

Adult ♀ about 2·6 mm. long and 1·3 mm. broad, elongate, very convex, with almost perpendicular sides and sloping abruptly in front and behind.

Female raised on a hollow waxy sheath which extends over the sides of the body, leaving the dorsum naked. The material is now ten years old and appears as though the waxy covering had once extended over the dorsum, but had become detached from it. If this were covered the insect would look like an *Inglisia*, except that the waxy covering is thin, pale buff-coloured and solid, i.e., without air-tubes.

Female, denuded of wax, densely chitinised, brown, shiny.

When cleared and mounted the integument of the dorsum is moderately dense, with numerous ± circular clear spaces as in *Saissetia* but of greatly varying size. The venter is thin and clear. The antennae are rudimentary, usually with about

three indistinct joints, always exhibiting pseudarticulations. In the longest antenna seen, after staining, one could observe 6 ill-defined joints measuring (1) 17, (2) 14, (3) 14, (4) 14, (5) 14,(6) 20μ.

Leg I: coxa 34; femur $\pm$ trochanter 85; tibia 85; tarsus 27; claw 17μ.

The margin has a scant series of short, curved, moderately stout spines, except near the anal cleft, where the spines are closer set, long (41μ), straight and very acute. The anal cleft is invariably thrown to one side and is not in the median line as in *Lecanium*. The anal ring has numerous (12?) hairs; anal plates about 120μ long. Embryo-larva large, about 420μ long, with 6-jointed antennae. Caudal extremity produced, with prominent caudal lobes, each with one long, stout seta (136μ) and several shorter spines.

Habitat: On grass or thin reed. Label in tube reads: "From Dr. Peringuey, S.A. Museum, Nov. 1908."

Collection No.: 140.

Genus **Membranaria,** nov.

Lecaniid, somewhat like *Pulvinaria* but with the cottony ovisac replaced by a membranous receptacle. Antennae and legs well developed, the former 7 or 8-jointed.

Type, *M. pretoriae*, sp. n.

246. **Membranaria pretoriae,** sp. n. (Plate iv, fig. 247).

Adult ♀ with ovi-receptacle about 5·5 mm. long, 2 mm. broad and 3 mm. high. Receptacle membranous, secreted from the margins, particularly the posterior margin, of the insect, so that, when completed, the insect, except the head end, is raised from the stem. The membrane consists of two coats, both thin, but which may be readily separated. The outer coat is pale, honey-comb yellow, not striated, and is produced from the upper margin of the insect. The inner coat is paler in colour and has longitudinal striae. The completed receptacle is hoof-shaped (fig. 247) with a distinct, dense, longitudinal, median keel. Its greatest length, along this keel, is about 3 mm.

The adult ♀ is deep caramel-brown, sometimes speckled with black, glossy, with a rounded, median ridge and marginal corrugations and depressions. Cleared and mounted the adult ♀ is moderately dense. Margin with a single row of simple, hair-like spines set wide apart. Submarginal area, except of anterior end, with a broad band of very numerous, small, gland pores, each with a curved, linear gland tube. Stigmatic cleft obsolete, but indicated by a pair of curious, short, broad, cup-like protuberances. Anal ring with 8 hairs; anal plates surrounded in front by a dense, rugose, chitinous plate.

Antennae 7 or 8-jointed; range in μ:—

I	II	III	IV	V	VI	VII	VIII
20–31	31–34	17–41	20–48	17–24	17–24	24–27	—
24–27	27–37	24–34	14–24	20–27	17–20	16–20	24–27

Leg I: coxa 102, femur + trochanter 238, tibia 153, tarsus 51, claw 20μ.

Habitat: On crowns of grass, in front of Union Buildings, Pretoria; collected by the writer, October 1914.

Collection No.: 83.

EXPLANATION OF PLATE I.

Fig. 233. *Lecanium elongatum*, Sign., adult ♀♀.

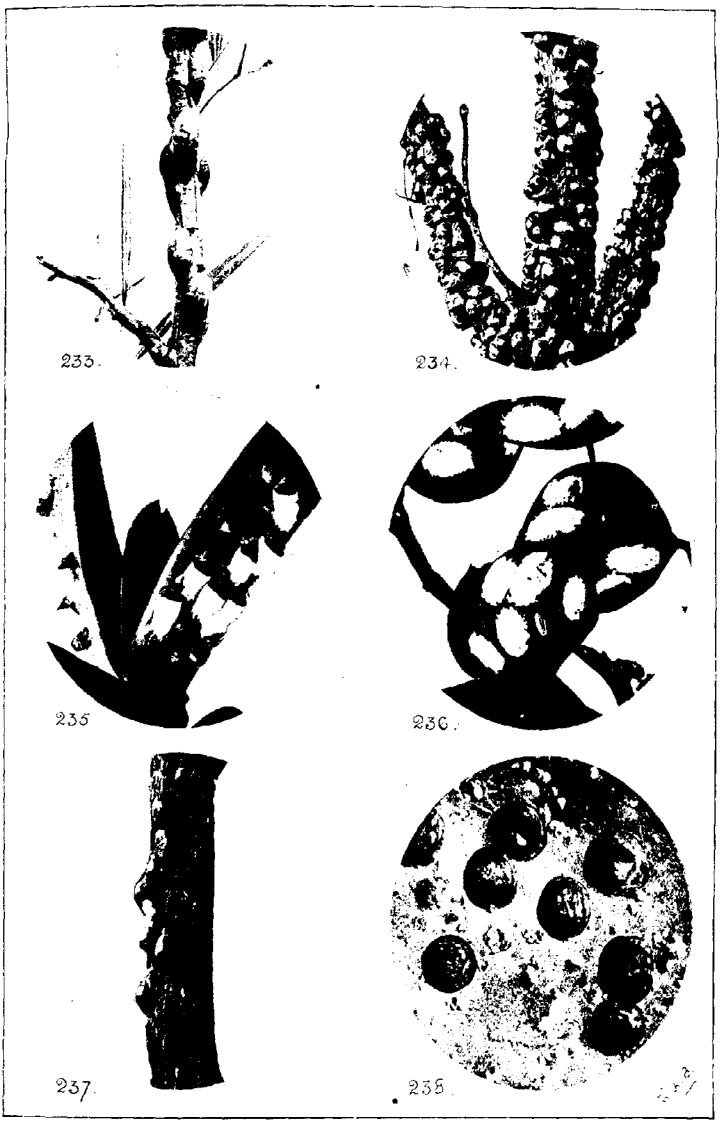
234. *Saissetia persimilis*, Newst., adult ♀♀.

235. *Pulvinaria mesembryanthemi* (Vall.) Sign., adult ♀♀ with ovisacs.

236. *Filippia carissae*, sp. n., adult ♀ with ovisacs completed and one ♂ puparium.

237. *Saissetia subpatelliforme*, Newst., adult ♀♀.

238. *Hemilecanium theobromae*, Newst., adult ♀♀.



SOUTH AFRICAN COCCIDÆ.

EXPLANATION OF PLATE II.

Fig. 239. *Ceroplastes eucleae*, sp. n., adult ♀♀.

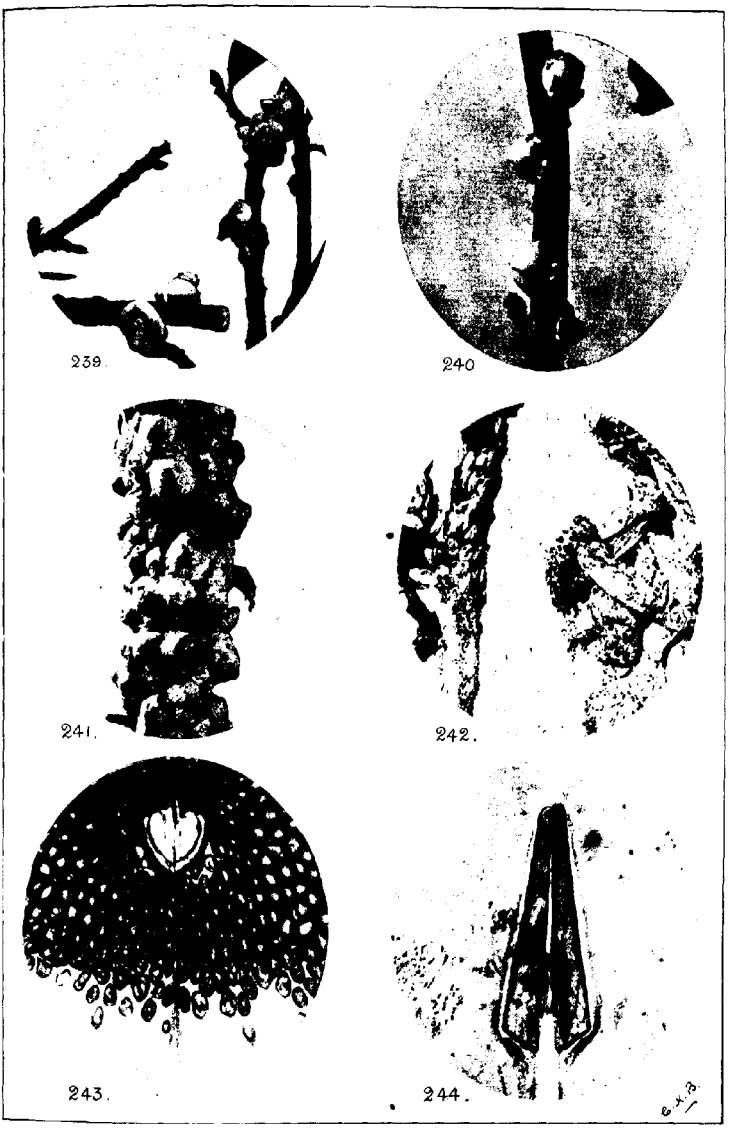
240. *Ceroplastes* sp.

241. *Ceroplastes mimosae*, Sign., adult ♀♀.

242. *Pulvinaria aristolochiae*, Newst., ♂ tests and ♀ ovisacs with larvae.

243. *Saissetia* sp., to illustrate dermal cells.

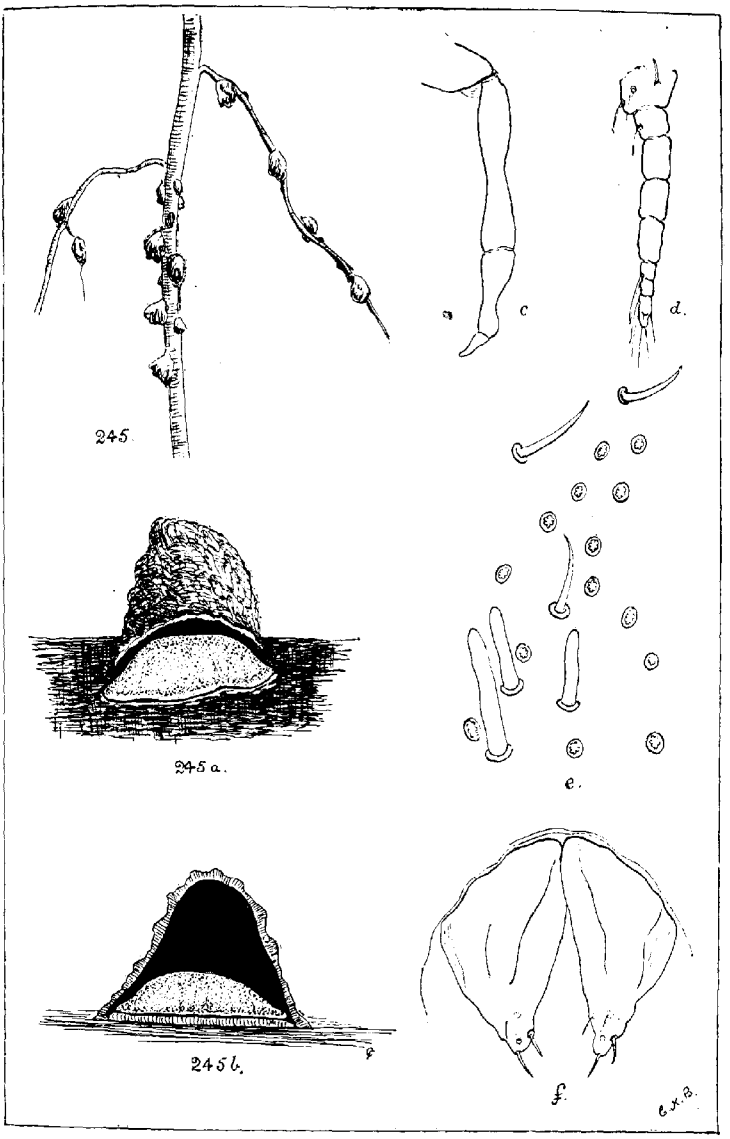
244. *Protopulvinaria piriformis* (Ckll.) Lefroy, anal lobes of adult ♀.



SOUTH AFRICAN COCCIDÆ.

EXPLANATION OF PLATE III.

Fig. 245. *Conofilippia subterranea*, sp. n., ♀ ovisacs on roots; *a*, ♀ with top of ovisac tilted to one side; *b*, section of ovisac with ♀; *c*, swollen tibio-tarsa joint; *d*, antenna; *e*, stigmatic spines and glands; *f*, anal lobes of ♀.



SOUTH AFRICAN COCCIDÆ.

EXPLANATION OF PLATE IV.

Fig. 246. *Allopulvinaria subterranea*, sp. n., adult ♀♀.

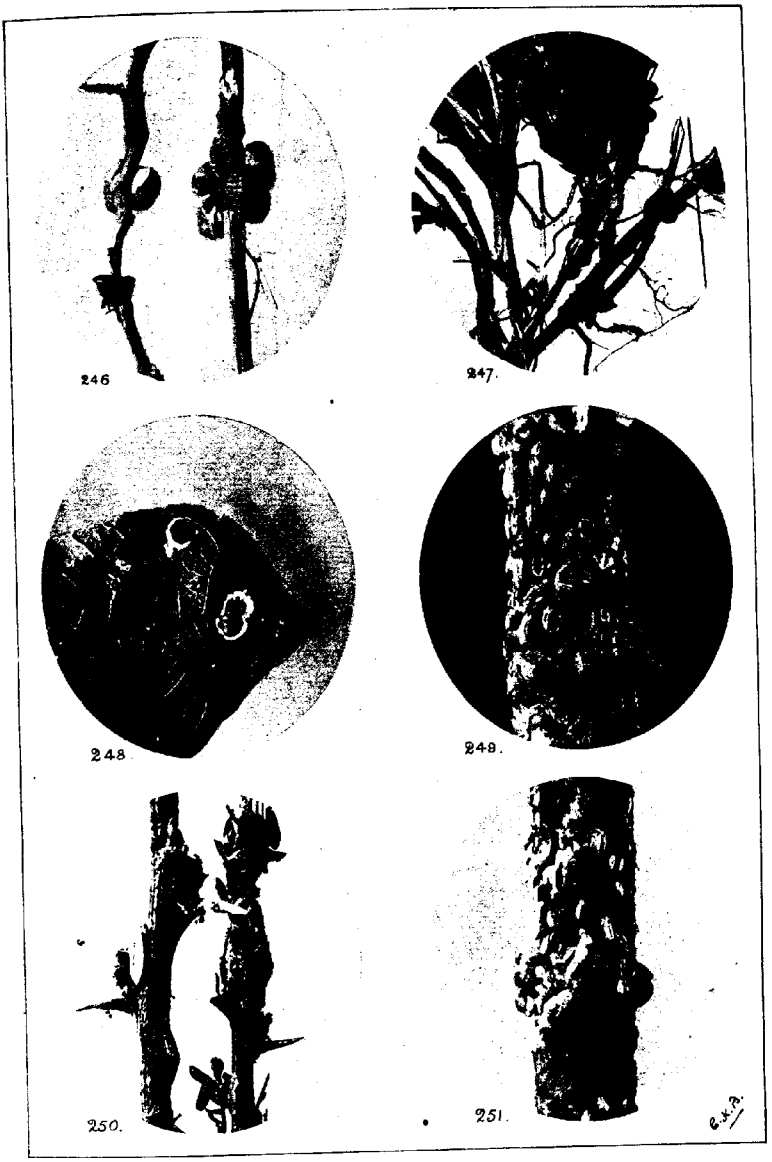
247. *Membranaria pretoriae*, sp. n., adult ♀♀.

248. *Protopulvinaria piriformis* (Ckll.) Lefroy, adult ♀♀.

249. *Inglisia geranii*, sp. n., young and adult ♀♀.

250. *Parafairmairea patellaeformis*, sp. n., adult ♀♀.

251. *Ceroplastodes bituberculatus*, sp. n., adult ♀♀ and ♂ puparia.



SOUTH AFRICAN COCCIDÆ.

THE PERCY SLADEN TRUST EXPEDITION TO THE INDIAN OCEAN IN 1905, AND 1907–1909, UNDER Mr. J. STANLEY GARDINER, M.A.

DIPTERA: TABANIDAE.

By Major E. E. Austen, D.S.O.

The material belonging to this family brought back by the expedition includes representatives of only four species, one of which, however, is apparently new. That three out of the four species obtained should belong to the *Aegophagamyia-Bouvierella* group is not surprising, in view of the predominance of this group in the Malagasy Subregion.

Through the courtesy of the authorities of the Percy Sladen Trust, the type of the new species described below has been placed in the British Museum (Natural History).

Pangoniinae.

Genus **Aegophagamyia,** Austen.

Ann. Mag. Nat. Hist. (8) ix, p. 12 (1912).

Aegophagamyia terticeps, Austen.

T. cit., p. 15.

Three ♀♀, from Astove I., 1907; four ♀♀ from Aldabra, 1908–9 (*J. C. F. Fryer*).

The type and para-type of this species, in the British Museum (Natural History), are from Astove I. (*P. R. Dupont*).

In the female sex, at any rate, this species bears a superficial resemblance to *Tabanus albipectus*, Big., for which on casual inspection it might easily be mistaken. The four specimens noted above as having been taken in Aldabra bear the same number as that attached to the examples of *Tabanus albipectus* collected in the same island, by Mr. J. C. F. Fryer, showing that the field note printed below under the heading *T. albipectus* must be taken as applying to the present species also.

Genus **Bouvierella,** Surcouf.

Bull. Mus. Hist. Nat., Paris, 1909, p. 176.

Bouvierella alluaudi, Giglio-Tos.

Scione allauudi, Giglio-Tos, Ann. Soc. Ent. France, lxiv, p. 357 (1895).

Of this species, originally described from specimens from the Seychelles Is., the present collection includes no fewer than twenty-two examples, as follows:— One ♂, one ♀, from Mahé, Seychelles, v-xii. 1905 (*J. S. Gardiner*); eleven ♂♂, five ♀♀, from Mahé, Seychelles (5 ♂♂, 2 ♀♀, from the Forêt Noire district, x-xi. 1908, and 6 ♂♂, 3 ♀♀, from Cascade Estate, at 800 to 1,000 feet or more above sea-level, 1908–9); one ♀, from Félicité, Seychelles, xii. 1908; 2 ♂♂, from Praslin, Seychelles, xi. 1908; and one ♀ from Cosmoledo Is., 1907 (*H. P. T.*).

Bouvierella inornata, sp. n.

♀.—Length (2 specimens) 10 to 11·2 mm.; width of head 3·25 to 3·6 mm.; width of front at vertex 0·4 mm., at lower extremity 0·25 mm.; length of wing 9 to 10 mm.

Sombrely coloured species, entirely devoid of markings; ground-colour of dorsum of thorax drab or dusky drab, that of dorsum of abdomen greyish fuscous; front in ♀ narrow, slightly narrower at lower extremity than at vertex, about six times as long as its width at upper end; wings, especially portion beyond basal and anal cells, strongly suffused with brownish, stigma well marked; coxae drab, legs otherwise blackish brown, extreme tips of femora, at least of those of front pair, ochraceous buff.*

Head: front, subcallus, face, sides of face and jowls drab, occiput smoke-grey; vertex clothed with minute, erect, blackish-brown hair, sides of face with ochraceous-brownish hair, basi-occipital region with longer fine brownish hair; *frontal callus* represented by a fine, dark, median line, commencing at some distance above level of lower inner angle of eyes, and not reaching anterior ocellus; *proboscis*, including labella, narrow and elongate, total length of proboscis about two-thirds of that of head; proximal joint of *palpi* dark brown or brownish, terminal joint similarly coloured on outer surface, narrow, curved, elongate and very slender; *antennae* dark brown, first and second joints clothed above and below with short, blackish hair, expanded portion of third joint ovate or elongate ovate when viewed in profile, without any angle on upper margin, annulate portion of third joint narrow, curved and elongate. *Thorax*: dorsum clothed with short, recumbent brownish hair, which in front of prescutellar groove may be mixed with paler hair, scutellum bearing longer brownish hair, or a mixture of brownish and ochraceous hair; pleurae and pectus agreeing in coloration with dorsum, and clothed with fine, brownish hair. *Abdomen*: dorsum clothed with short, appressed dark brown hair, venter agreeing with dorsum in coloration and hairy covering. *Wings*: lengths (relative as well as actual) of stalks of first and fourth posterior cells variable in different specimens; stigma elongate, dark brown. *Squamae* light drab or drab-grey, borders drab. *Halteres*: knobs clove-brown or blackish brown, stalks paler (cinnamon-buff). *Legs* sparsely clothed with short or minute dark brown or blackish hair.

Seychelles Is. Type from Silhouette (plateau of Mare aux Cochons, about 1,000 feet, ix. 1908); a paratype from Mahé (Cascade Estate, 800–1,000 feet), 1908–9.

Bouvierella inornata is distinguishable from all previously described species belonging to this genus, *inter alia*, by its uniformly sombre coloration, the ground-colour of the thorax and abdomen not being relieved by either lighter or darker markings. In particular, it is distinguished from *B. brunnea*, Surcouf (Bull. Mus. Hist. Nat., 1909, no. 4, p. 179), a species found in Madagascar, by its smaller size, and by the more uniformly dusky coloration of the body and legs, the dorsum of the thorax not being longitudinally striped with grey, and the legs not being reddish yellow, clothed with golden pile.

In the length and slenderness of the proboscis, including the labella, the species just described agrees rather with *Aegophagamyia*, Austen, with which it constitutes in this respect an annectent link; as regards antennal characters and the shape of the first posterior cell, however, the species seems more correctly placed under Surcouf's genus.

* For names and illustrations of colours, see Ridgway, "Color Standards and Color Nomenclature" (Washington, D. C.: published by the Author, 1912).

TABANINAE.

Genus **Tabanus**, Linn.

Fauna Suecica, Ed. ii, p. 462 (1761).

Tabanus albipectus, Bigot.

T. albipectus, Bigot, Ann. Soc. Ent. France, (3) vii, p. 125, pl. ix, fig. 2 (1859).

Twenty-one specimens, from various localities as follows:—One ♀, from Poivre Is., Amirante Is., v-xii. 1905 (*J. S. Gardiner*); one ♀, from I. des Roches, Amirante Is., 15. x. 1905; one ♀, from Aldabra, 1907 (*H. P. T.*); 15 ♀♀, from Aldabra, 1908–9 (*J. C. F. Fryer*); one ♂, two ♀♀, from Long Island and Mahé, Seychelles (Cascade, about 1,000 feet), 1908–9.

A comparison of the foregoing material with the type of the species, taken in Madagascar by Dr. Coquerel and now in the British Museum, places the correctness of the identification beyond doubt. In addition to the type of *T. albipectus*, the National Collection includes a ♂ and ♀ from Astove I. and Aldabra respectively (*P. R. Dupont*), and a ♀ from Pigaduli, Zanzibar, "on goat," 14.x.1912 (*Dr. W. M. Aders*).

To the specimens from Aldabra in the present series, taken by Mr. J. C. F. Fryer, the following interesting field-note was attached:—"Most numerous in December [1908]: attack sea-turtles, biting them between the plates on the back: apparently attack them in water as well as on land. Were seen flying all over the lagoon, and also some way out at sea. They fly strongly, and bite man also." As already explained, this note must be taken as applying equally to *Aegophagamyia terticeps*, Austen (*vide supra*). With reference to the biting of reptiles by blood-sucking Diptera, it may be remembered that the typical series of *Tabanus crocodilinus*, Austen, was taken on a crocodile in Nyasaland (*cf.* Austen, Bull. Ent. Res., ii, p. 285 (1912)), while in Uganda, as is well known, *Glossina palpalis* feeds readily upon crocodiles and monitors.

ON THE REASONS FOR THE VARIATION IN THE EFFECTS OF FORMALDEHYDE AS A POISON FOR HOUSE-FLIES.

By Capt. Ll. Lloyd, D.Sc., R.A.M.C. (T. F.).

The following is an account of an investigation carried out on behalf of the Hygiene Department of the Royal Army Medical College at the suggestion of Prof. Maxwell Lefroy, who, after his visit to the Mesopotamia War Area in 1916, was insistent on the importance of the discovery of some poison for house-flies (*Musca domestica* and allied species) that could be used indoors with safety. The work was carried out in the Entomological Department of the Imperial College of Science in the early part of 1917. Large stocks of flies which were kept breeding in two rooms were available for the purpose.

Formaldehyde has been frequently recommended as a poison for flies, but those who tested its effects gave varying accounts of it. Miss Lodge (1), who studied it in some detail, was unable to account for these variations and stated that no definite conclusions could be drawn from her work. An analysis of the various factors which might cause such variations was made, and it was found that there were three which play an important part. These are (1) impurities in the formaldehyde, (2) the humidity of the atmosphere, and (3) the strength of the solution used.

The following subjects will also be discussed, (4) the advantage of adding a bait, (5) the most effective mode of administration, and (6) comparison with other poisons.

"Formaldehyde" must be understood throughout to mean the 40 per cent. solution in which it is usually sold, and all strengths are given as percentages of this. "Formalin," the trade name of one brand, is often loosely used for this solution.

Impurities in the Formaldehyde.

Formaldehyde is prepared by passing a mixture of heated air and the vapour of methyl alcohol over some heated contact agent, such as copper gauze or silver. The methyl alcohol is crude or pure, but should be 90 per cent., and should not contain more than 1 per cent. of acetone. The purity of the product depends largely on that of the methyl alcohol, and on the freedom of the air from ammonia. The following substances are liable to be present: trioxymethylene, methylal, methyl and ethyl alcohols, acetone, hexamethylene tetramine, methylamine, and formic acid. Prof. Baker, of the Imperial College of Science, provided samples of formaldehyde to which certain of these substances had been added in proportions in which they are liable to occur. Solutions of these, generally in water and soaked up in clean sand, were exposed side by side with solutions of the control formaldehyde in the fly room, and left for twenty-four hours. The numbers of dead flies in the immediate neighbourhood of each were then counted. Many flies left the table to die and no account could be taken of them. There was always a definite group dead in a circle of six inches radius around each jar, and the comparisons were based on these. In order to obviate the influence of the varying numbers of flies on different days, all numbers are given reduced to percentages of the controls. All decisions are based on a number of tests, with the positions of the various solutions and the controls interchanged.

Of the impurities tested, hexamethylene tetramine, methylamine and formic acid were found to be of importance, and these only will be discussed. The effects of the presence of the other substances mentioned above were investigated and found to be neutral, or of very little importance.

Hexamethylene tetramine, $(CH_2)_6N_4$.

This substance is produced by the action of ammonia on formaldehyde. It is liable to occur in the solution owing to the presence of ammonia in the air during manufacture. It breaks down with the formation of methylamine, $CH_3 NH_2$. Formaldehyde containing these bodies has a yellowish colour and a fishy odour, both these characteristics being intensified by the addition of a strong alkali. These substances are distasteful to flies. A sample containing 5 grms. of hexamethylene tetramine added per litre was tested against a control. The residue from the manufacture of this substance, containing ammonia and methylamine, and some methylamine hydrochloride, with and without an alkali to set free the methylamine, were also tested with the following results.

TABLE I.

Showing the Influence of Hexamethylene tetramine in Formaldehyde.

Solution	Percentages of flies killed	Average %	Total flies killed
Formaldehyde control, 10%	100 in each case	100	324
Formaldehyde with 5 grms. hexamethylene tetramine added per litre, 10%	74, 130, 93, 71, 57	85	267

TABLE II.

Showing the Influence of Methylamine in Formaldehyde.

Solution	Percentages of flies killed (actual numbers in brackets)	
Formaldehyde control, 10%	100 (50)	100 (20)
,, with 2·5% hexamethylene tetramine residue 10%	36 (18)	
,, with 1% hexamethylene tetramine residue 10%		65 (13)
,, with 1% methylamine hydrochloride 10%		40 (8)
,, with 5% methylamine hydrochloride and 0·2% KOH 10%	30 (15)	
,, with 1% methylamine hydrochloride and 0·1% KOH 10%		30 (6)

A sample, naturally containing these substances in unknown proportion, with a pale yellow colour and fishy odour (previously unsealed bottle from the store of the Imp. Coll. Sci.) was tested against a colourless control with a clean odour.

The results of the tests are summarised in the next table. In nearly every case the purer sample proved the more effective. No suggestion can be given for the purification of formaldehyde of this nature, and it should be avoided if any other is obtainable.

TABLE III.

Comparing a Yellow Formaldehyde with Fishy Odour (Methylamine) with a Clean Sample.

Solution	Percentages of flies killed	Average %	Total flies killed
Formaldehyde control, 10%	100 in each case	100	1509
,, impure, ,,	134, 67, 96, 89, 230, 36, 17, 68, 58.	89	1118

Formic acid, H·CO·OH.

Formaldehyde is prepared by the dehydrogenation of methyl alcohol: $CH_3OH + O = CH_2O + H_2O$. Theoretically in the process there is no formic acid formed. The samples of formaldehyde examined, however, were all found to be acid. Three which were titrated were found to be +24, +39, and +60 acid (Eyre) respectively. (A fluid "+x acid" requires x ccs. of normal alkali to make one litre neutral.) The acid present was proved to be formic by a test suggested by Dr. A. M. Whiteley. A few ccs. of the formaldehyde are shaken up with lead carbonate and quickly filtered. If formic acid is present crystals of the sparingly soluble lead formate separate out in the filtrate after a short interval. The crystals are minute, very characteristic needles. On the assumption that formic was the only acid present, these samples contained 1·1, 1·8, and 2·76 grms. of formic acid per litre respectively. When the dilute poison 5–10 per cent. formaldehyde is made up the acid would be present in amounts varying from ·0055 to ·0276 per cent. Even these small quantities are detected and disliked by flies.

TABLE IV.

Showing the Deterrent Effect of Formic Acid in Water.

Solution	No. of tests	Av. flies tasting	Av. flies drinking	Av. percentage which drank
Tap water control	2	35	24	69
Formic acid ·1%	1	33	3	10
,, ·05%	3	32	15	47
,, ·02 ·04%	4	36	20	54
,, ·01 ·065%	3	36	18	50

Temperature 77·9° F.; relative humidity 57%.

Testing saucers, two inches in diameter, were filled with solutions of formic acid in water and covered with discs of blotting paper to soak up the fluid. These were then exposed one at a time in the fly room and watched for five minutes, a count

being taken of the numbers of flies which visited and tasted the solution and then left, and of those which remained to drink. Controls were made with tap water. A fly only "tastes" when it presses its proboscis one or more times against the wet surface, and quickly withdraws it. It "drinks" when the proboscis remains pressed against the surface for a few seconds or longer. Apart from the count, an impression may also be gathered from the behaviour of the flies. On a fluid which they find attractive they cluster, but on an unattractive one there are never more than two or three flies at one time. The total number of visiting flies was about constant in each test.

The disadvantages of the presence of formic acid in formaldehyde are shown by the following tests, where a solution containing 12 grms. per litre was tested against the one containing 1·8 grms. per litre. In ten tests the less acid solution killed twice as many flies as the more acid one.

TABLE V.

Showing the Disadvantages of the presence of Formic Acid in Formaldehyde.

Solution	Percentages of flies killed	Av. per cent. killed	Total killed
Formaldehyde 1·8 grms. $H \cdot CO \cdot OH$ per lit. 10%	100 in each case	100	808
,, 12·0 grms. $H \cdot CO \cdot OH$ per lit. 10%	54, 78, 54, 27, 34, 38, 34, 51, 43, 50	50·6	366

Flies are less readily repelled by dilute alkaline than by acid solutions, and will drink solutions containing 0·1 to 0·2 per cent. caustic potash, or 0·07 per cent. lime, as readily as water. There is possibly even a little attraction in it. The following Table VI shows this, the data being obtained in the same way as those in Table IV.

TABLE VI.

Showing that certain weak Alkaline Solutions are not deterrent.

Solution	No. of tests	Av. flies tasting	Av. flies drinking	Av. percentage which drank
Tap-water control	5	38	31	83
KOH 2%	1	35	0	0
,, 0·3–0·4%	2	31	14	45
,, 0·1–0·2%	2	34	30	91
$Ca(OH)_2$, 0·14% (lime water)	2	37	20	54
,, 0·078%	2	33	20	61
,, 0·07%	3	37	30	81

Temperature 77° F.; relative humidity 57%.

It is therefore advisable always to add as much alkali to the formaldehyde as possible, without deterring the flies, to neutralise any formic acid which may be present, or any which may be formed by oxidation during the exposure of the solution. Table VII shows the benefit of the procedure.

TABLE VII.

Showing the Advantages of adding certain Alkalis to Acid Formaldehyde.

Solution, 10% in each case	Percentages killed (actual numbers in brackets)
Control formaldehyde (12·5 grms. H·CO·OH per lit.)	100 in each case
,, +50% lime water in dilution	283 (155), 241 (82)
,, +K_2CO_3, 15 grms. per lit. (equiv.).	300 (36), 268 (147), 270 (92)
,, +$(NH_4)_2CO_3$, 10 grms. per lit. (equiv.).	68 (37), 82 (28)
Control formaldehyde (1·8 grms. H·CO·OH per lit.)	100 in each case
,, +100% lime water in dilution	76 (47), 90 (923)
,, +50% ,, ,, ,, ,,	114 (269), 104 (312), 142 (57)
,, + 1% K_2CO_3	125 (50)
,, + 1% NH_4OH	50 (20)
Control formaldehyde (1·1 grms. H·CO·OH per lit.)	100 in each case
,, +50% lime water in dilution	131 (297), 124 (31)
,, +25% ,, ,, ,, ,,	110 (28)

It will be seen that the addition of the alkali improved the effect in every case except when the whole fluid of dilution was lime water, which made it too strongly alkaline, and when ammonia was used, methylamine being formed in these cases. Lime water is recommended in practice in preference to other alkalis because it is a weak solution of definite strength. It is prepared by allowing cold water to stand over lime, slaked or unslaked, for a few hours and then filtering the solution before use. Such a solution contains 0·14 per cent. $Ca(OH)_2$. If made with hot water the solution is weaker. The maximum amount, half the total fluid of dilution, should always be used to counteract the formic acid which would otherwise be formed after dilution, during exposure to the air, or by the bodies of dead flies falling in. In a trap which will be presently described, but an imperfect model, which was exposed in the fly room, this was very clearly shown. The fluid in the trap was 7·5 per cent. formaldehyde, 35 per cent. lime water (equivalent to the acid present), and 5 per cent. sugar. On the first three days this trap killed 1,800 flies, and then became ineffective. Four flies had crept into the poison, and when this was titrated it was found to have become +2 acid. An equivalent of KOH was added and it became again effective.

Humidity of the Atmosphere.

A test was made at a temperature of 96° F., and the poison was found to be effective. There is no reason apparent why it should not be effective in a tropical country. The humidity of the air, however, plays a considerable part, as indeed

it must with any poison which is administered as a drink. In wet weather flies have less inclination to drink and there is more moisture available, so that they are less likely to discover the trap. Experiments were made to test this.

(i). A jar with an area of 2·5 sq. in. was filled with sand wetted with a 10 per cent. solution of formaldehyde without any addition. It was placed in the centre of a dish of dry sand, area 95 sq. in., and this was placed in a greenhouse containing a large number of flies. No water was available and the atmosphere was dry. After twenty-four hours 1,560 dead flies were counted on the surface of the sand, or within a few inches of the dish. The experiment was repeated with approximately the same number of flies available and the same atmospheric conditions, but in this case the sand in the surrounding dish was wetted with water, equally with the poisoned surface. After twenty-six hours only 20 flies were found dead, the majority having obtained their water from the unpoisoned surface.

(ii). This series was carried out in a glass cylinder 24 in. high and 10 in. in diameter. Wet and dry bulb thermometers were included. The formaldehyde (10 per cent. in water) was supplied soaked up in sand, area 2·5 sq. in. The duration of each experiment was twenty-two hours. The air was in no case quite dry, as the amount of moisture given off by the poisoned surface is considerable in this confined space. It was found that the formaldehyde was effective with a relative humidity of 76 per cent. and 72 per cent., that its effect was about halved with a relative humidity of 81 per cent., and that above 90 per cent. it was much reduced, available water being present throughout in this case. The results are given in Table VIII. From these it may be concluded that liquid poisons will not be very effective if much other available moisture, such as dew, is present. Formaldehyde works well in a room where there is a wet sink, as was the case in the fly room where these experiments were performed. It would be useless, however, to place the poison in the sink or immediately over it, though it will be found very effective a few feet away. Flies are usually going about looking for food, and seem to taste all moisture they come across in their wanderings, either in the hope of its containing food or simply for the sake of the drink. Their capacity for utilising solid food depends on whether the crop contains fluid with which to dissolve it.

TABLE VIII.

Showing the decreasing effect of Formaldehyde with increasing Humidity.

Conditions in Cylinders	Temp.	Rel. Humid	Total flies	Percentage killed
$CaCl_2$ added to dry the air	79·1°	72%	229	94
Air not treated	74·9°	76%	125	89
Wet blotting paper as base	77·0°	81%	66	47
Wet blotting paper as base and top	76·3°	93%	90	17

(iii). Experiments with baited formaldehyde under saturated conditions were made. It was found that the baits about doubled its efficacy, but the results were still very unsatisfactory. The details are given below in Table IX. Sugar in water was the bait and the formaldehyde was employed in various strengths, being supplied

in two-inch saucers with blotting-paper covers. Each series was continued for two days and the cylinders were kept as wet as possible, though in several cases they dried somewhat towards the end, with a corresponding increase in the death-rate. The controls were on a dry table with muslin tops to the cylinders, the relative humidity being about 76 per cent. The fourth experiment in Table VII is taken as a control for the saturated conditions with unbaited formaldehyde. To obtain a proper estimate the percentages dead at the end of twenty-two hours should be studied. Another series carried out in precisely the same way, but with bread-water as a bait instead of sugar, gave very closely similar results and will therefore not be detailed.

TABLE IX.

The effect of Baited Formaldehyde compared under Wet and Dry Conditions.

Solution	Conditions	No. of flies	Percentages dead after :		
			5 hrs.	22 hrs.	48 hrs.
No bait, formaldehyde 10%	wet	90		17	
Sugar 5% ,, ,,	dry	38	32	97	100
,, ,, ,, ,,	wet	34	3	35	79
,, ,, ,, 7·5%	dry	32	44	91	100
,, ,, ,, ,,	wet	28	3	23	69
,, ,, ,, 5·0%	dry	21	43	100	100
,, ,, ,, ,,	wet	23	4	22	78
,, ,, ,, 2·5%	dry	19	21	79	100
,, ,, ,, ,,	wet	17	0	6	82

Humidity and the use of formaldehyde on ships.

Lt.-Col. W. Byam, R.A.M.C., reported that while he found formaldehyde very effective on board ship, it failed to be of use in Egypt. This is in accordance with the variations in the accounts of its utility. That used in Egypt was possibly too acid. Experiments were devised to discover what its effect would be on board ship where the atmosphere is moist, but not necessarily saturated, and where most of the available water is salt, owing to all the woodwork being saturated with this substance.

(1). A cylinder was washed inside with 10 per cent. salt solution, flies were introduced and blotting-paper soaked in the salt solution placed above and below; a shelter was erected over the poison dish to prevent the salt water dripping in. A control was set up, fresh water being used instead of salt solution. It was found that the flies were poisoned about twice as rapidly in the one with salt water as in the one with fresh water.

(2). This was carried out in cylinders, a bait being used in the poison which was soaked up in jars of sand (area 2·5 sq. in.) that were placed in dishes of sand (area 13·5 sq. in.) wetted in one case with 10 per cent. salt solution and in the other with water. The atmosphere would be very moist from the vapour given off by the wet sand,

TABLE X.

Showing the Effect of Formaldehyde when available Water is strongly saline.

Solution	Conditions	Total flies	Percentages dead after :		
			3 hrs.	28 hrs.	48 hrs.
Formaldehyde 10% in water	Saturated with salt solution	29	14	69	93
Formaldehyde 10% in water	Saturated with fresh water	27	4	39	78

and the conditions would approach those on board ship when it is not actually raining. The results, which are given in Table XI, are very striking, as the flies died rapidly when the available water was saline, and slowly when it was fresh. By further experiment it was found that the flies drink as readily as water a solution of 1 per cent. salt, that stronger solutions deter them, while 5 per cent. and upwards repels them entirely. Formaldehyde properly neutralised and baited will be found very effective on board ship.

TABLE XI.

Showing the Probable Effect of Formaldehyde on Board Ship.

Solution	Conditions	Total flies	Percentages dead after :		
			2 hrs.	5 hrs.	24 hrs.
Formaldehyde 7·5%, lime water 50%, sugar 5%	Salt water available	94	22	43	96
	Fresh water available	38	3	21	63

The Strength of Formaldehyde to be used.

The question as to the most effective strength of formaldehyde was approached from two points of view; firstly, the stronger the solution the less likely are the flies to drink much; secondly, a little of a strong solution, or a large quantity of a weak solution, will kill them. These will be discussed under the headings of "The Deterrence of Formaldehyde" and "The Toxicity of Formaldehyde." The results were then combined, giving the optimum concentration. At the same time control experiments were made in cylinders as a check to the conclusion drawn.

The Deterrence of Formaldehyde.

The deterrence of formaldehyde was determined by the same method as that employed with formic acid, already described. Each series of different strengths was exposed, one at a time and in quick succession, in the same spot where the numbers of available flies were about constant. The numbers which only tasted and the numbers which drank were counted and the percentage of the latter to the

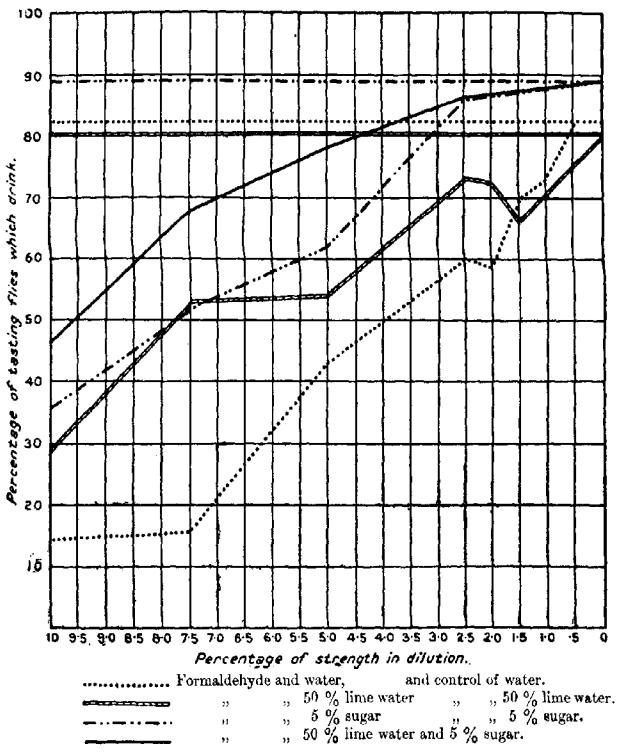


Diagram 1. Showing the deterrence of acid formaldehyde and its remedy.

former gives the factor to the solution. Controls were made with water alone, with 50 per cent. lime water, and 5 per cent. sugar solution, and each series was checked by one or more repetitions. The time allowed to each exposure was five minutes. The following solutions were thus studied: formaldehyde in water; formaldehyde in 50 per cent. lime water; formaldehyde in sugar solution; formaldehyde in 50 per cent. lime water with sugar. The detailed results are given in

Table XII, and in Diagram 1. In the diagram the points represent the percentages of the tasting flies which remained to drink. The bottom dotted line represents formaldehyde and water, and shows that any mixture of these is deterrent as compared to the water control, of which an average of 82 per cent. of the tasting flies drank. The 10 per cent. formaldehyde deterred from drinking nearly 82 per cent. (67 out of 82) of the tasting flies which would have drunk had there been no formalde-

TABLE XII.

Showing the Deterrence of Formaldehyde, and its Remedy.

Solution		No. of tests	Total flies	No. of flies tasting			No. of flies drinking			Percent. of drinking to tasting flies		
				Av	Max	Min	Av	Max	Min	Av	Max	Min
Water controls		8	263	33	48	26	27	35	20	82	95	72
,, formaldehyde	10%	6	221	37	46	30	5	13	1	15	34	2
,, ,,	7·5%	6	190	32	35	27	7	13	0	16	38	0
,, ,,	5·0%	6	195	32	38	26	14	19	9	43	59	24
,, ,,	2·5%	6	221	35	48	26	22	27	15	60	73	52
,, ,,	2·0%	4	148	39	63	24	21	33	13	59	71	52
,, ,,	1·5%	4	151	38	47	29	26	34	19	70	80	64
,, ,,	1·0%	2	75	37	38	37	28	31	26	75	81	70
,, ,,	·5%	2	74	37	38	36	30	31	30	82	83	81
Lime water controls	50%	3	112	37	39	35	30	31	29	80	86	72
,, formaldehyde	10%	4	136	34	42	25	5	11	9	29	36	24
,, ,,	7·5%	4	121	30	40	23	16	21	11	53	71	40
,, ,,	5·0%	4	122	30	33	28	16	21	11	54	67	37
,, ,,	2·5%	4	114	28	31	26	21	23	17	73	85	54
,, ,,	2·0%	2	64	32	33	31	23	25	21	72	76	68
,, ,,	1·5%	2	70	35	39	31	23	27	20	66	69	64
Water, sugar controls	5%	1	45	45			40			89		
,, formaldehyde	10%	2	76	38	45	31	14	21	8	36	46	26
,, ,,	7·5%	2	63	31	36	27	17	23	11	52	63	41
,, ,,	5·0%	2	71	35	38	33	22	23	21	62	69	55
,, ,,	2·5%	2	66	33	35	31	28	31	26	86	88	84
Lime water 50% sugar 2·5%		2	60	30	30	30	14	14	14	47	47	47
,, formaldehyde	10%	2	72	36	41	31	24	29	20	68	71	65
,, ,,	7·5%	2	60	30	35	25	23	27	20	78	80	77
,, ,,	5·0%	2	52	26	27	25	22	24	21	86	89	84
,, ,,	2·5%											

Temp. av. 77° F. (78·9–76·0°). Rel. humid. av. 50% (58–39%).

hyde present, and so on. The line of dashes represents the percentages which drank the formaldehyde in 50 per cent. lime water. It is higher than the previous one because, while the deterrent influence of the formaldehyde remains as before, that of the formic acid is removed. It also is always below the water and lime water controls. The next line of dots and dashes represents formaldehyde and 5 per cent. sugar, without lime water. The presence of the bait has partly counteracted the

deterrence, so that at 3 per cent. it is equal in its attraction to the water control, and at 2·5 per cent. approaches very near to the control of sugar and water. The continuous line represents the mixture which is finally recommended, 50 per cent. lime water and 2·5 per cent sugar. It is equal to the water control at 5·5 per cent., and then becomes more attractive than water because the flies recognise in it a food, while the formaldehyde is not repellent enough in weak solution to deter them in large numbers. At 5 per cent. only 12 per cent. fewer flies drank than would have done so if the solution were sugar and water only. At 2·5 per cent. formaldehyde, only 3·5 per cent. declined to drink. The neutralisation of the formic acid and the addition of the bait have at this point nearly counteracted the deterrent action of the formaldehyde. It is of considerable interest to notice that the lines which represent the formaldehyde with and without lime water are parallel in pairs, while those with and without sugar converge in pairs at 2·5–1·5 per cent. This shows the influence of the presence of formic acid in very dilute solutions. The formaldehyde used proved on titration to be + 60 acid (Eyre) which is equivalent to 2·76 grams of formic acid per litre of formaldehyde. At 5·0 per cent. dilution this is 0·014 per cent. formic acid, and at 2·5 per cent. it is 0·007 per cent. formic acid. The presence of sugar is sufficient to counteract the latter but not the former. A factor which has not been taken into consideration is that the formaldehyde vapour may be deterrent and that fewer flies may taste stronger than weaker solutions. This was not apparent in the open, but showed itself when the experiment was repeated in enclosed spaces. There was then progressive deterrence as the strength of the solution increased, as was shown by the smaller percentage of the available flies which settled on it. The curve of this deterrence is represented by the dotted line in Diagram II. Consideration of it will show that its fall is so gradual that it would not affect the argument even if its influence were as powerful in the open as in the enclosed space, since the influence of the other factors is so much more potent.

The Toxicity of Formaldehyde.

In determining this factor, the solution used was 50 per cent. lime water and 2·5 per cent. sugar, only the percentage of formaldehyde varying. About 50 flies were enclosed in each of several glass basins of capacity of 600 cc. The basins were then placed over saucers containing the poison and a count was taken of the flies that tasted and those that drank. In the first series the time allowed was fifteen minutes, but it was found that all the flies that intended to drink did so in the first five minutes, and the exposure was subsequently limited to this time. The poison was then removed and the edge of the basin slightly raised to allow air to circulate. At the end of one hour and of two hours the numbers lying inert were counted, the difference between the two counts representing the recoveries, as formaldehyde seems to act as an anaesthetic, and its effect in weak solution, or when a very little is taken, is sometimes only temporary. No recoveries were noted after two hours. All the flies were then anaesthetised and counted. Four series of each percentage were thus made. The complete results are summarised in Table XIII. This shows the total and average numbers of flies exposed to each percentage of formaldehyde used (from 2·5 to 20 per cent.); the average, maximum and minimum numbers of flies which tasted; the average, maximum and minimum percentages of those which drank

compared to those which tasted; and the percentages of those temporarily and permanently incapacitated compared with those which drank. The calculation of the numbers of those which died against those which drank is more satisfactory than calculating them against those which only tasted. The numbers thus obtained are frequently above 100, as at a strength of 5 per cent. and upwards the amount taken by a fly in its taste is often enough to kill it. Reference to the table will show that not only the averages, but also the maxima and minima, run in series corresponding to the strength of the poison, allowance being made for occasional variation due to experimental error. The percentage of those which died compared to those which drank gives the factor of toxicity to each strength of formaldehyde. These factors are plotted in Diagram 2 and are represented by the line of dashes. The toxicity increases rapidly from 15 per cent. upwards, and falls rapidly from 5 per cent. downwards, the rise from 5 per cent. to 15 per cent. being gradual. The dot and dash curve is taken from Diagram 1, with the addition of the factors for 15 per cent. and 20 per cent. strengths which are taken from Table XIII. This curve represents the percentage of tasting flies which remain to drink a solution of formaldehyde containing 50 per cent. lime water and 2·5 per cent. sugar. It is the curve of deterrence. By combining these two curves a hypothetical curve is constructed which is represented in the diagram by the continuous line. For example with a strength of 10 per cent. formaldehyde exposed in the open, 47 per cent. of the flies that taste it will remain to drink. Some however will absorb enough poison in the taste to kill them, and the number which finally die is not 47 per cent. of the tasting flies but 133 per cent. of 47, that is, 62·5 per cent. of the flies that taste die. The relative effects of different strengths of formaldehyde, as represented by the curve, were thus found. It is a natural curve with its maximum at 5·0–6·0 per cent. formaldehyde, and this is therefore the optimum strength to use in practise. The straight dotted line in the same diagram represents, as explained above, the deterrence of the vapour at different strengths in enclosed spaces. Its tendency is to recommend the use of as weak a solution as possible, but the decline in the effect below 5 per cent. is so rapid that this factor could play no part in the decision as to which strength to use.

TABLE XIII.

Showing the relative Toxicity of various strengths of Formaldehyde.

Solution 50% lime water, 2·5% sugar		Tests no.	Total flies	Av. no. flies	% of flies tasting			% of tasting flies which drank			% to drinking flies			
											Down in 1 hour	Dead after 2 hours		
					Av.	Max.	Min.	Av.	Max.	Min.		Av.	Max.	Min.
Formald.	20%	4	154	39	43	67	30	20	25	15	229	219	300	125
,,	15%	3	138	44	41	53	35	30	36	25	146	143	150	140
,,	10%	4	220	55	53	55	45	54	67	43	136	133	156	110
,,	7·5%	4	182	45	59	69	49	68	76	63	111	112	136	87
,,	5·0%	4	219	55	61	65	53	86	93	79	106	103	121	86
,,	2·5%	4	174	43	66	80	54	91	96	87	51	39	62	23

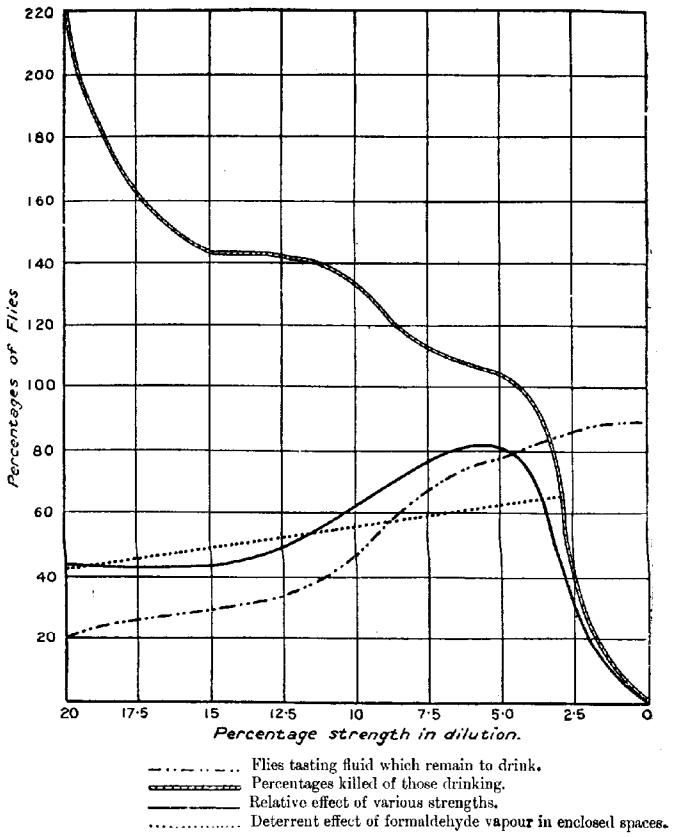


Diagram 2. Showing the most effective strength of formaldehyde.

The Optimum Concentration.

The conclusion drawn from the experiments just described was checked by the following series of further experiments. In each series concentrations of 10 per cent., 7·5 per cent., 5·0 per cent., and 2·5 per cent. formaldehyde, with 50 per cent. lime water and 2·5 per cent. sugar, were placed in saucers with blotting paper covers and these were exposed to flies in cylinders (10 in. diam., 8 in. high). Each experiment was continued for twenty-four hours, and counts were made at intervals of the flies lying inert. Seven series were completed, and about 100 flies were used in each cylinder. The summary of the whole is given in Table XIV. In this are shown the average number of flies in each cylinder, and the average percentages inert at the end of various intervals. These results are plotted in Diagram 3; the dot-and-dash line represents 2·5 per cent. formaldehyde; the continuous one 5 per cent.; the line of dashes 7·5 per cent.; the dotted line 10 per cent. Although recoveries are only

indicated in the case of 2·5 per cent., they occurred occasionally also in the case of 5 per cent. and 7·5 per cent. strengths. This method confirms the conclusion that the most effective strength to use is 5 per cent., then 7·5 per cent., then 10 per cent., while 2·5 per cent. is the least effective. The factors of effect of these concentrations had been found to be 80·3, 76·1, 62·5, and 33·5 respectively.

TABLE XIV.

Showing the Death-rate of Flies exposed to various strengths of Formaldehyde.

Formaldehyde strength	No. of tests	Av. no. flies	Av. percentages inert after:				
			1 hour	3 hours	4 hours	5 hours	24 hrs.
10%	7	81	33	45	54	58	92
7·5%	7	92	44	53	63	65	93
5·0%	7	98	51	58	64	72	96
2·5%	7	96	42	48	57	53	89

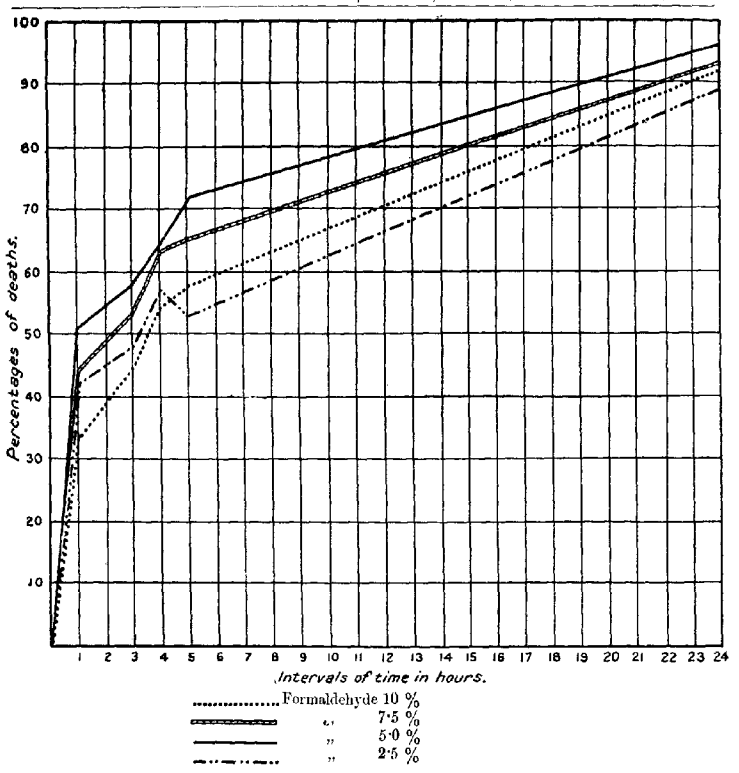


Diagram 3. Showing the relative strengths of formaldehyde.

Advantages of adding a Bait.

Reference to Table XII and to Diagram i will show that to get the best effect from the formaldehyde it is necessary to add some bait to counteract the deterrent effect. By this means a larger number of flies are induced to drink. Sugar is the most attractive and most permanent bait, and 2·5 per cent., or half an ounce to the pint, in the dilution is sufficient; to make it stronger does not make it more effective, while at 1 per cent. it begins to lose its influence. An advantage of this substance is that it has no interaction with the formaldehyde. Glucose, maltose and lactose have also been tried, but are less effective than cane sugar. Molasses will be found effective. An infusion of hay, boiled and strained, and a cold infusion of horse-dung have been tested and found to be effective, but less so than sugar, and they are not recommended for this reason.

The formula to be employed is:—

40 % Formaldehyde, 50–60 cc.	1 fluid ounce.
Filtered lime water, 500 cc.	½ pint.
Sugar, 25 grams	½ ounce (dessertspoonful).
Water, add to make 1,000 cc.	add to make 1 pint.

Method of Administration.

It is necessary to protect the formaldehyde from the action of air, and to prevent flies from falling into it, both of which factors make it acid, and soon cause the lime water to be neutralised. A simple form of trap has been devised for this. The poison is placed in a bottle, and the mouth is closed by means of a platform of absorptive material from the centre of which a stem of the same material passes down into the fluid. The top is wetted with the fluid at the commencement and is kept wet by

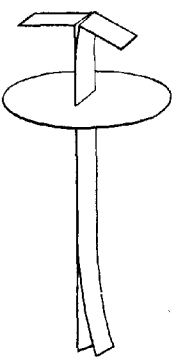


Fig. 1. Form of trap for use with formaldehyde.

capillary attraction. Such an arrangement may easily be made from blotting paper. A circle of the paper two inches in diameter is cut out, and a small slit is made in the centre. Two strips of the paper of the same width as the slit are then passed through it and the ends are doubled outwards and downwards. The strips are then drawn down till the doubled-back portions rest on the platform, and the trap is ready for use (see fig. 1).

This form of trap may be used under cover or outside when it is not raining. The paper should be renewed every third or fourth day in any case. A more permanent form may be made from plaster of Paris or some other durable material, porosity being an essential. The stem in this case is circular and should be in one piece with the top, or fit into it very tightly, otherwise the fluid will not rise. It may be necessary to soak this trap in water occasionally and dry it.

These traps have been submitted to the very severe tests of being placed near dishes of the food which has been found most attractive to house-flies, casein, banana and bread, mixed and wetted. One trap with the top made of plaster of Paris was placed about a foot away from a large dish of this material, and in three days poisoned 1800 flies, which were found on, or within a few inches of it. After further neutralisation it became effective again and remained so for ten days, about half the original fluid (200 cc.) having been used. Another one, with the top made of filter paper two inches in diameter, was placed in a corner of the fly room, and was active for ten days until it was removed, the paper top having been renewed once; 1,560 flies were found dead around it. A third one with a paper trap was still active at the end of a month. Whether a trap is still effective may be determined by sweeping away the dead flies from its vicinity. If no more flies accumulate, and there are still flies about, the fluid has probably become acid and should be renewed, as it will not be found worth while in practice to neutralise it again. The traps should be placed wherever flies are numerous, especially near rubbish bins, in stables, near manure heaps, in kitchens and latrines. Observation will show which are the best positions.

Comparison with other Poisons.

Formaldehyde as a fly poison was not tested against sodium arsenite, but it has two great advantages over it: it is safe and it is more economical. With 2 per cent. sodium arsenite solution 10 per cent. sugar is recommended, while formaldehyde only requires a quarter of that amount. The use of sodium arsenite would always be dangerous to man and to domestic animals, especially if issued to the general public. That the poison used shall be safe in any hands is a great desideratum.

The action of formaldehyde was tested against that of sodium fluoride, recently recommended as an effective fly poison (Jackson and Lefroy). Formaldehyde (5 per cent.) and sodium fluoride (1 per cent.) in saucers were placed in two separated halves of a deep glass dish, equally lighted and heated. No baits were used in either. After twenty-four hours in the formaldehyde section 650 flies were dead as against 234 dead in the sodium fluoride section. As more might have escaped from the section containing the fluoride than from the other section, a control comparison was made with cylinders of flies, four containing as poison 1 per cent. sodium fluoride with 3 per cent. sugar, and four containing the formaldehyde mixture recommended above. Notes were made of the death-rate and it was found that there was no appreciable difference in the actions of the two poisons. The results are summarised in Table XV. However from the first experiment it is seen that flies poisoned travel less from the formaldehyde than from the fluoride, which is an advantage. Authorities differ as to whether sodium fluoride is a poison to man, but as it is used in food preserving it is certainly not a very dangerous substance.

TABLE XV.

Comparing the Effects of Formaldehyde and Sodium Fluoride as Fly Poisons.

Solution.	No. of tests.	Aver. flies.	Aver. percentages dead after:		
			1 hour	4 hours	24 hours
1% sodium fluoride, 3% sugar	4	111	57	76	94
5% formaldehyde, 50% lime water, 3% sugar	4	74	66	74	96

Summary.

The effective action of formaldehyde as a fly poison depends on the freedom of the exposed fluid from formic acid, and, to a less extent, from methylamine. That used for fly poisoning should therefore be colourless and free from a fishy odour, and a weak alkali, in slight excess, should be added in dilution to neutralise any acid present and that which will be formed during exposure. The formula recommended is :—

40% Formaldehyde	5–6%
Clear lime water	50%
Sugar	2·5%
Water	add to make 100

This should be exposed in a trap which will protect it from the air and will prevent flies from falling in. Formaldehyde, like any other stomach poison for flies, will be most effective under dry conditions.

References.

1. O. C. Lodge, Proc. Zool. Soc. Lond., Sept. 1916.
2. Thorpe, Dictionary of Chemistry, on formaldehyde.
3. Mally, C. W. "On the use of poisoned bait for controlling the house-fly;" S. African Journal of Science, June 1915.
4. Jackson and Lefroy, "Some Fly Poisons for Outdoor and Hospital Use;" Bull. Ent. Res. vii, p. 327.

AFRICAN APHIDIDAE.—PART IV.

By FRED. V. THEOBALD.

The following new species of Aphids have been sent from Africa; four are from a collection forwarded by Mr. Claude Fuller of the Department of Agriculture of the Union of South Africa (*Macrosiphum cissi*, *Phorodon violae*, *Capitophorus chrysanthemi* and *Forda natalensis*); one has been sent by Mr. C. C. Gowdey from the British East African Protectorate which has to be placed in a new genus (*Cerciaphis*).

Macrosiphum cissi, sp. nov. (fig. 1).

Alate viviparous female.

Antennae longer than body, rather dark, pale at base of third segment; basal segment wider and a little longer than second; third longer than fourth, not so long as sixth, with a line of 15–18 sensoria extending nearly to the end of the segment the distal one usually markedly separated from the others; fourth segment a little longer than fifth, the latter with the usual sub-apical sensorium; sixth with long flagellum and usual sensoria at apex of basal area; fourth to sixth markedly imbricated; with short, simple, scattered hairs. Eyes large and dark. Frontal lobes small, but prominent, median ocellus prominent; head with slightly spatulate

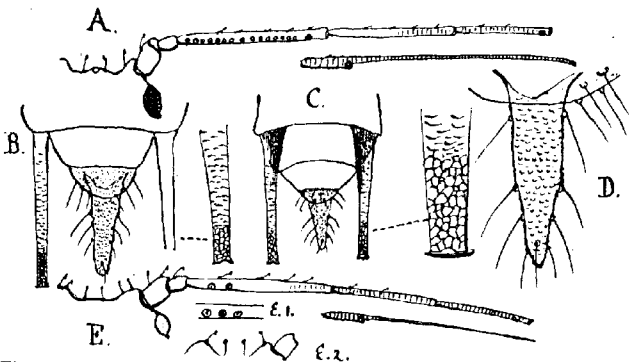


Fig 1. *Macrosiphum cissi*, sp. n.: A, head of alate ♀; B, cornicles and cauda of apterous ♀; C, cornicles and cauda of alate ♀; D, cauda of alate ♀; E, head and antenna of apterous ♀.

hairs. Proboscis rather broad, dark at apex, reaching to or just beyond the second coxae, apical segment a little longer and narrower than second. Legs long and thin, dark at apices of femora and tibiae, tarsi dark, most of hind femora dark, short hairs over apex of femora and tibiae. Cornicles black, long and cylindrical, about as long as third antennal segment, apex reticulate, remainder imbricated. Cauda about one-half the length of cornicles, pale, with three pairs of long lateral hairs, a smaller apical pair and a median sub-apical one. Anal plate darker and with many hairs. Cauda not quite level with apices of cornicles. Wings normal. *Length*, 2–2–3 mm.

Apterous viviparous female.

Antennae longer than body; first to third segments pale, except apex of latter, remainder dark; first segment much larger than second; third longer than fourth, but shorter than sixth, with a group of 2-6 sensoria near the base; fourth longer than fifth, the latter with usual sub-apical sensorium, both combined a little shorter than sixth to about the same length; flagellum of sixth long; hairs normal. Head with well formed frontal lobes and with a small median prominence showing only in some specimens; other mounted specimens show the vertex almost flat. Eyes large and dark. Proboscis reaching to or just beyond the second coxae; apical segment longer and considerably narrower than the penultimate. Cornicles dark, cylindrical, somewhat expanding basally, reticulate at apex, remainder imbricated; shorter than third antennal segment. Cauda pale, about half as long as cornicles and slightly thicker, with three hairs on each side and some apical ones; not quite reaching the apices of the cornicles. Legs relatively shorter and thicker than in alate female; apices of femora and tibiae and tarsi darkened; hairs moderate. Anal plate dusky, with rather long hairs. Hairs of body slightly spatulate. *Length* 2·2-2·5 mm.

Nymph.

Antennae longer than body; darkened on fifth and sixth segments; basal segment larger than second; third longer than fourth; fourth longer than fifth; the sixth much longer than 4+5; flagellum long, but relatively shorter than in mature forms; a few scattered hairs. Proboscis with dark apical segment, reaching to the third coxae; last two segments nearly equal. Wing pads dusky; cornicles dark; about as long and as thick as third antennal segment, imbricated; reaching past the cauda. Cauda triangulate, pale, with two pairs of lateral hairs. Legs with dusky apices to tibiae, but not to femora; latter with hairs on one side; tibiae hairy. *Length* 1·8 to 2 mm.

Food-plant. Cissus sp.

TRANSVAAL: Pretoria 18.x.1918.

Described from three alate females and a number of apterous females and nymphae. No colour notes were sent, but the species is so well marked that I have described it. It comes nearest to *Macrosiphum*, but also approaches *Myzus*, especially in the alate stage. Mounted apterae show the vertex in different forms, some have it almost flat, others of typical *Macrosiphum* form, whilst others show a median prominence. In the various larval instars the differences are great; the first has very short thick cornicles, in later stages they increase in length. The length of the cornicles varies in the adults.

The plant upon which these Aphids were found—*Cissus*—is one of the Order Ampelideae. This genus is often merged into *Vitis*. None of the species recorded from *Vitis* agrees with Mr. Fuller's specimens, and so far no Aphid has been recorded from *Cissus*.

The Aphids recorded from *Vitis* are *Aphis illinoisensis*, Shimer; *Aphis ripariae*, Oestlund; *Aphis vitis*, Scopoli; *Macrosiphum viticola*, Thomas; *Hyalopterus arundinis*, Fabricius; *Peritymbia vitisana*, Westwood; *Rhizoctonus ampelinus*, Mokrzeki; *Schizoneura ampelorhiza*, Del Guercio; and three species of *Phylloxera*.

Rhopalosiphum carduellinum, Theobald (fig. 2).

Bull. Ent. Res. vi, p. 112. figs. 9 and 10, (1915).

Apterous viviparous female.

Antennae about as long as the body, arising from prominent frontal tubercles; basal segment much larger than second; third not quite as long as the sixth, with 17–20 small sensoria along one side; fourth slightly longer than fifth, with 3–6 sensoria; fifth with normal sub-apical sensorium; sixth about as long as 4+5, its basal area about one-fourth the length of the fifth; the apices of segments 3–5 are darkened and there is a dark area at junction of basal area and flagellum of sixth; all the segments are imbricated; the sensoria on 3 are of varied size and shape;

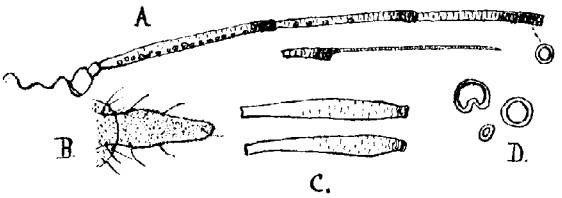


Fig. 2. *Rhopalosiphum carduellinum*, Theob., apterous female; A, head and antenna; B, cauda and anal plate; C, cornicles; D, sensoria on 3rd antennal segment.

those on 5 are more regular in outline. Proboscis reaching to just past the second pair of legs; two bands of a few hairs on penultimate segment; two marked sub-apical ones on the apical arising from clear circular areas. Legs with apices of femora and tibiae darkened and dark tarsi, a few hairs on apex of femora and numerous short ones on the tibiae. Cornicles about as long as the fourth antennal segment, about twice as wide and somewhat swollen on the apical half; apex with a few striae, remainder faintly imbricated. Cauda pale, broader than cornicles, more than half their length, with three long hairs on each side and a curved sub-apical one; reaching just beyond the apices of cornicles. *Length*, 1·8–2 mm.

Food-plant. Thistles (*Carduus* sp.).

TRANSVAAL: Pretoria, 20.v.1914 (*C. Fuller*); Onderstepoort, 28. vii. 1914 (*G. B. Bedford*).

Type in the British Museum.

The apterous female sent with the alatae of this insect appears to be a distinct species. The sensoria in the two apterous females sent by Mr. Claude Fuller appear so much more closely allied that I have little doubt that they are true *carduellinum*.

Numbers of nymphae sent were mostly all of a uniform pale colour, evidently yellow or green, but a few show the tips of the wing pads dusky. One of the sensoria on the third antennal segment is markedly bean-shaped, and the varied size of the others is somewhat characteristic.

Phorodon violae, sp. nov. (fig. 3).

Apterous viviparous female.

Yellowish green to dull pale yellow. Antennae longer than body, of same colour as body except extreme tip of fifth and whole of sixth segments, which are dark;

basal segments (1 and 2) somewhat darker than the rest; the basal one much larger than second and somewhat projecting on its inner side; third segment longer than fourth, but not so long as sixth; fourth and fifth about equal in length; flagellum moderately long, about as long as third; a few scattered hairs over the segment and the third with short stiff hairs arising from small projections along one side, some extending on to the fourth; basal segment imbricated. Frontal lobes large, with

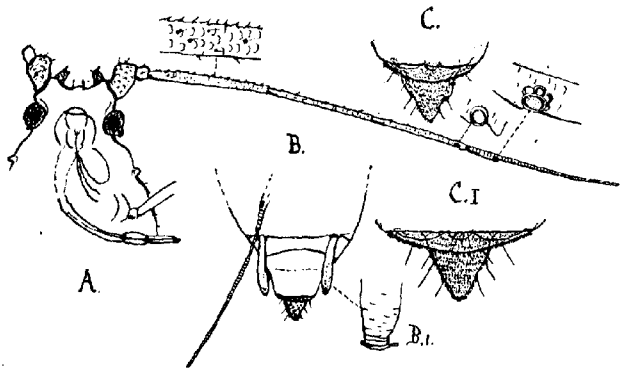


Fig. 3. *Phorodon violae*, sp. n., apterous viviparous female: A, head of apterous ♀; B, posterior end of body and end of antenna; B. 1, cornicle; C, C.1, cauda.

a marked, slightly inwardly directed, cone-like process on each side, imbricated and with two minute hairs. Two stiff hairs also project from the vertex. Eyes large, red to dark red. Proboscis pale, apex slightly darkened; reaching to or just beyond the third coxae, narrow; apical segment a little narrower and longer than penultimate. Legs of same colour as body, except the tarsi which are darkened; very short stiff hairs on the tibiae. Cornicles of same colour as body, moderately long, but shorter than the fourth antennal segment, slightly swollen from the middle onwards; faintly imbricated, sometimes slightly expanded at the base. Cauda pale, short, bluntly triangulate, spinose, with two short hairs on each side; projecting well beyond the cornicles. Anal plate slightly darkened, narrow, spinose, with four long apical hairs and others somewhat shorter. On each side of pronotum a small lateral papilla and traces of four others on each side of the abdomen. The body is contracted at the apex. *Length*, 1·3–1·8 mm.

Nymph.

Colour similar to adult. Antennae about as long as body and of same colour; sixth segment and apex of fifth dusky; basal segment much larger than second, third a little longer than fourth; fourth and fifth about equal; sixth as long as or a little longer than 4+5, its basal area about half the length of the fifth. Frontal processes as in alate female. Eyes bright red. Wing-cases of same colour as body, also the legs, except apices of tibiae and the tarsi, which are smoky, with numerous fine short hairs. Cornicles and cauda pale, the latter bluntly triangulate and

extending beyond the cornicles, which are shorter than the fifth antennal segment. Cauda finely spinose, but showing no lateral hairs. The pale proboscis reaches nearly to third coxae. *Length*, 1·2–1·5 mm.

Food-plant. Pansy.

NATAL: Durban, 1.x.1912.

Described from a number of apterous females and some nymphae. Nearly all the females have the posterior portion of the gut, etc., evaginated, giving them a curious ragged appearance. The shape of the body is also marked.

I have placed this species provisionally in the genus *Phorodon* on account of the two marked frontal processes and the swelling on the basal segment of the antennae, but the cornicles and cauda do not exactly fit in with that genus, taking *P. humuli*, Schrank, as the type. The flattened anal plate occurs, however, in some stages of the hop aphid.

Capitophorus chrysanthemi, sp. nov. (fig. 4).

Apterous viviparous female.

Apparently a pale green or yellow species, with black eyes; dusky apices to the cornicles and antennae; tarsi all dark and to some extent the apices of the tibiae; hairs capitate. Antennae longer than body; basal segment larger than second and somewhat angulated on the inner side; third segment much longer than fourth

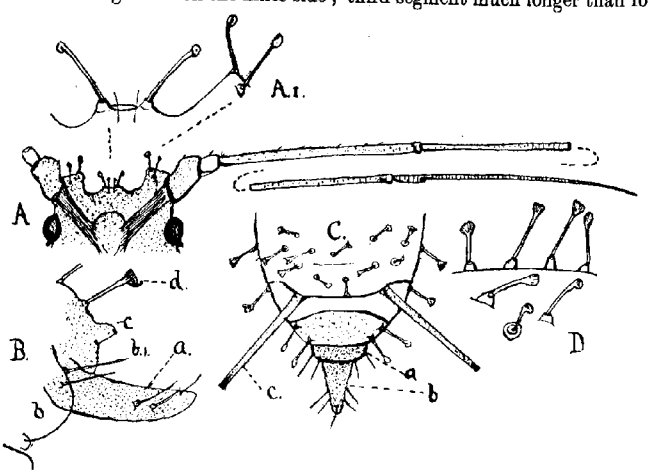


Fig. 4. *Capitophorus chrysanthemi*, sp. n.: A, head of apterous ♀; A. 1, enlarged cephalic hairs; B, anal region; *a*, cauda; *b*, anal plate; *b*. 1, hairs of anal plate; *c*, dorsal process; *d*, body hairs.

but not so long as the sixth; fourth a little longer than fifth, the latter with the usual sub-apical sensorium; sixth with long flagellum, basal area about one-fourth of the fifth segment. Head with marked frontal lobes and a median raised process; with two capitate hairs on each lobe, two in front on the median lobe, and two just above them. Eyes prominent, varying from black to deep red or reddish black. Proboscis pale, reaching to just past the second coxae; apical segment

narrow and acuminate, penultimate nearly as long, expanded. Legs pallid, except tarsi, which are dusky except at extreme base; tibiae with moderately long fine hairs and a few on apex of femora. Cornicles long and very thin, about as long as fourth antennal segment; pale, apex dark. Cauda pale, rather long and thick, bluntly elongate-triangular, with two hairs on each side, close together towards the apex and a median sub-apical one; finely spinose. Anal plate slightly darker, spinose and with a few long hairs, broadly rounded. The thin cornicles project to about the level of the cauda, which is very much wider and about half to less than half their length. Body hairs strongly capitate, some with fan-shaped extremities, whilst those on the anal plate and cauda are simple. The lateral view shows a small tubercle above the cauda (fig. 4, B. c.). *Length*, 1·8–2 mm.

Food-plant. Chrysanthemum.

ORANGE FREE STATE: Bloemfontein, 18.v.1914.

Described from several mature apterous females. It resembles a typical *Myzus*, but the median frontal projection places it in Van der Goot's genus *Capitophorus*; which appears to be undoubtedly well marked, but I find so many species between the true *Myzus* and typical *Capitophorus* that it is doubtful if this genus should be accepted, unless many others are to be initiated.

Genus **Cerciaphis,** nov.

Described from apterous viviparous females.

Head flat to very slightly concave in front. Antennae shorter than body, of five segments, the third about as long as 4+5; the fifth longer than fourth, its flagellum only half the length of basal area. Eyes small. Cornicles small, cone-shaped. Two thick, acuminate anal cerci, about as long as fourth segment of antennae. Cauda small, flattened. Anal plate rounded. Proboscis rather short.

Cerciaphis bougainvilleae, sp. nov. (fig. 5).

Apterous viviparous female.

Pale-coloured; apices of antennae dusky. Eyes small and dark. Legs, cornicles, anal plate, cauda and base of antennae of same colour as body. Head narrower

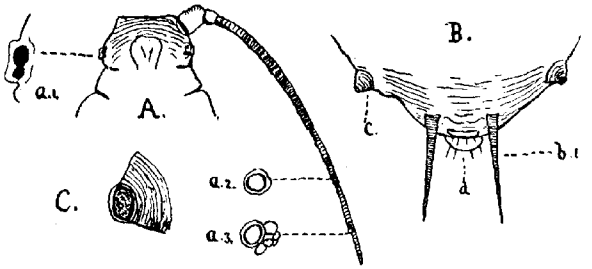


Fig. 5 *Cerciaphis bouganvilleae*, sp. n.: A, head of apterous ♀; *a.* 1, enlarged eye; *a.* 2, and *a.* 3, sensoria; B, posterior end; *b.* 1, cerci; *c*, cornicle; *d*, cauda and anal plate; C, cornicle.

than body, which is more or less oval; head flattened to slightly concave in front, integument strongly striate. Antennae shorter than body, of five segments, the

basal one larger than second, the third the longest, as long as or longer than 4+5; the fourth shorter than fifth, with a simple round sub-apical sensorium; the fifth with the flagellum short, about half the length of the basal area, which is equal in length to the fourth segment; third to fifth imbricated. Cornicles cone-shaped, of Lachnid appearance, more or less circularly striate. Two long, pale, acuminate anal cerci, striate and about the length of the fourth antennal segment to a little longer. Anal plate pale, small, with a few longish hairs. Cauda inconspicuous. Legs rather short and thick. The posterior integument is striate, but not so markedly as the cephalic. The proboscis in all the mounted specimens is bent forwards but appears to reach to about the second coxae. *Length*, 1·4–1·8 mm.

Food-plant. Bougainvillea.

UGANDA: Kampala, 14.v.1919 (*C. Gowdey*).

Described from a number of apterous viviparous females. It is a very marked insect on account of the two posterior cerci. The head and body seem almost devoid of hairs, except posteriorly. The nymphae have long narrow wing-buds.

Forda natalensis, sp. nov. (Fig. 6).

Apterous viviparous female.

Globular, much domed dorsally, flattened ventrally. Grey, greyish white to brown; antennae, proboscis and legs brown. Segmentation marked posteriorly. Antennae from one-fourth to one-fifth the length of body; of five segments, basal one about half the length of second, third the longest, about as long as 4+5; fourth shorter

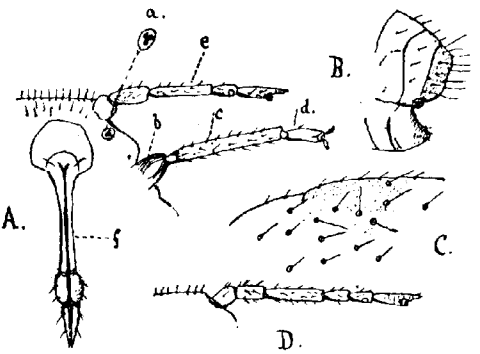


Fig. 6. *Forda natalensis*, sp. n.: A, head; B, cauda, C, integument of apterous viviparous ♀; D, nymph.

than fifth; fifth with a short blunt nail, a large rather projecting sensorium at its base and traces of a secondary one, also a round sensorium at the apex of the fourth; slightly hairy; last two segments darker than remainder. Vertex flat, with a few short blunt hairs. Eyes very small, black. Proboscis reaching to near the third pair of legs or just past them, moderately broad; apical segment a little longer and narrower than the penultimate, with a few short hairs. Legs rather short and thick, prothoracic shorter than mesothoracic, the latter shorter than the

metathoracic; tibiae and tarsi with short fine hairs, a few on the femora; femora of first and second pairs nearly as long as tibiae, the third a little shorter. Body with short fine scattered hairs, except at the apex, where they are longer. *Length*, 2–2·5 mm.

Immature viviparous female.

Paler, legs pale brown; antennae dark on last two segments only. Antennae about one-fifth the length of the body; basal segment shorter than second and very little broader; third a little longer than second; fourth about as long as the first; fifth a little shorter than third, with a small blunt nail, with normal sensoria at its base; a few scattered hairs. Proboscis reaching to or beyond the third pair of legs. Legs short, just projecting beyond the body, the first slightly shorter than second, third the longest; tibiae and tarsi with hairs as in adult. Eyes very small. Body with a few rather short scattered hairs. *Length*, 1·5–2·0 mm.

Food-plant. Roots of a weed and in ants nest.

NATAL: Umzinto, 23.iv.1911.

Described from several apterous viviparous females and some immature forms. It somewhat resembles *Forda rotunda*, Theobald, but can at once be distinguished by the long second antennal segment and the short fourth segment, also by the flat vertex and different posterior structure. The eyes also do not project in the same way, and the body is clothed with scattered fine short hairs.

Some specimens show a partial constriction on the third antennal segment, but I could find none in which it was complete, so that they are only of five segments.

Species not previously recorded or from new Localities.

Macrosiphum dahliafolii, Theobald, Bull. Ent. Res. vii, p. 273, 1918.

UGANDA: Kampala, 2.xii.1917 (*Gowdey*); on thistles (*Carduus*).

Macrosiphum sonchi, Linnaeus. Syst. Nat. ii, p. 735.

UGANDA: Kampala, 2.xii.1917 (*Gowdey*); on thistles (*Carduus*).

One apterous ♀, which agrees with British specimens. The darkening of the antennae around the sensoria of the third antennal segment is very marked.

ANOPHELES BREEDING AMONG WATER LETTUCE—A NEW HABITAT.

By JAMES ZETEK, B.A.,

Entomologist, Ancon, Panama Canal Zone.

With the filling up of Gatun and Mira Flores Lakes, water lettuce (*Pistia stratiotes*, Linné) and water hyacinth (*Eichornia crassipes*, Solms.) rapidly increased in numbers until large areas became completely covered by them. Masses of these plants would become detached and float about in these lakes. It was found necessary to destroy these "floating islands," not because they were serious mosquito habitats, but because they interfered with navigation and the operation of the spillways. The water lettuce is the habitat of the very specialised larvae of *Mansonia*, of which *titillans* is the commonest member. Knab (1913) and Busck (comments appended to Mr. Knab's paper) refer to the changes in the mosquito fauna brought about by the rapid increase in *Pistia*. Both *Mansonia titillans*, Walker, and *Aëdomyia squamipennis* (Lynch-Arrib.) Theo., have been collected by me in very large numbers since 1912, and to-day *Mansonia* is the dominant species caught in the army barracks on the west side of the canal. Knab expressed the opinion that perhaps measures would have to be taken to destroy the *Pistia* habitats; now that we have found *Anopheles* larvae in them, this prophesy comes closer home.

The only question involved is how much of a menace are these floating islands to our towns. It is my belief they are a menace to the towns on the west side of the canal, and if allowed to float toward Paraiso and Pedro Miguel, or close to Gatun, would be a source of danger there. It has been shown conclusively that our common malarial *Anophèles* do fly more than a mile (Zetek, 1915); in fact, it appears that they will fly as far as they must in order to get food. Should Las Cascades become a negro settlement, the dangers from malaria would be increased. I doubt if we can depend upon screening and mosquito-catching indoors to control the *Anopheles* and malaria at such a settlement. At any rate, the idea seems to be getting firmly established that the sanitation of the Panama Canal Zone is so efficient that there is virtually little danger from the *Anopheles*, and as a result our people are becoming somewhat negligent. It will depend mainly upon the cumulative evidence gathered by the District Sanitary Inspectors, whether or not these floating islands will need to be controlled.

That this evidence may be available and accurate, it is very necessary that the sanitary inspectors make it their practise to take ample field notes. These should contain as complete a statement of the particular habitat, date and locality added thereto, and specimens of the larvae should be sent to the laboratory for the accurate determination of the species. At the close of each month a general summary of these notes should be made, a copy of which should be sent to the entomologist. It is a regrettable fact that much valuable information is lost or buried in the heads of observers.

In 1918 I found *Anopheles* larvae among water lettuce at Juan Mina, a citrus plantation about five miles up the old Chagres River. On 21st November 1919, Messrs. Picket and Tolar, sanitary inspectors at Pedro Miguel, Dr. D. P. Curry,

Assistant Chief Health Officer, and I, made an inspection of floating islands at Gamboa, C. Z., both in the canal prism and across in the bayous; we went as far as Empire. Mr. Pickett previously reported the presence of *Anopheles* larvae in these islands at this place, and that they were going southward toward his station. Our joint inspection revealed larvae of *Anopheles albimanus*, Wied., and *A. tarsimaculatus*, Goeldi, to be plentiful among the leaves of the water lettuce. An unidentified *Culex* was also present.

This particular habitat is very favourable to the *Anopheles*. The larvae are afforded much protection from the schools of young fish that usually feed upon insect larvae. They are also protected to some extent from predaceous insect larvae, such as those of dragon-flies. Shade is another important factor in this habitat, and this means a more even temperature, and an almost total absence of the direct hot rays of the sun. Wave action does not disturb these larvae very much; but the most important advantage to them is the exceptionally favourable presence of oxygen, and this certainly must be effective in prolonging the life of the larvae and pupae. This factor is very easily explained. The *Pistia*, being a green plant, gives off oxygen. Its leaves are at or just above or below the surface of the water. Therefore this oxygen enriches the local atmosphere available to the larvae, and some of it is undoubtedly taken up by the water and made use of by the larvae through their cutaneous respiration.

During the summer of 1911, while engaged by Dr. S. A. Forbes to study the *Anopheles* at Havana, Illinois, a similar condition was found to exist, excepting that in place of *Pistia* the plant in question was the tiny *Lemna*. This plant covered the surface of the water in the bayous, ponds and quiet recesses of the rivers. The Chatagua grounds at Havana were invaded each year by *Anopheles*, but their source was not known until we found them in and among the floating islands of this *Lemna*. These islands broke away from the almost continuous mass across the river from Havana and by current and wind were swept across this deep body of water and came to rest along the shores of the Chatagua grounds; here the larvae developed, pupae formed and adults emerged in rapid succession.

There is one important aspect of this sort of habitat which must not be overlooked. It is that wind and current detach portions of this floating vegetation and sweep it across deep bodies of water to new localities, where were it not for this exceptionally good vehicle these larvae would be unable to cross the barrier of deep water.

Searching through the literature available at our laboratory, I find that Ingram and Macfie (1917) found larvae of *Anopheles costalis*, Lw., and *A. marshalli*, Theo., in exactly the same sort of habitat, composed of the same species of *Pistia*, at Christiansborg, near Accra, West Africa. Associated with them were: *Aëdomyia africana*, Nev.-Lem., *Mimomyia splendens*, Theo., *Culex quasigelidus*, Theo., and *Mansonioides africanus*, Theo.

In a previous paper, in which he discusses the limitations of kerosene as a larvicide, Macfie (1917) states (p. 278) that *Mansonioides africanus* flies over one mile and that its breeding places can be located with fair accuracy, inasmuch as they are composed of *Pistia*. On page 278 he states it is useless to hope for a total abolition of such mosquitos by ordinary oiling, and that a layer of kerosene (p. 294), no matter

how thick, applied to the surface of the water in which larvae of *M. africanus* live is absolutely innocuous. He is right, and this is corroborated by our observations upon *Mansonia titillans*, which is our counterpart to his *M. africanus*. But nowhere in this article, nor in the preceding one, does he touch upon the control of the *Anopheles* which live in this same habitat, nor does he refer to the use of emulsions which mix with the water and kill by contact, or the destruction of the *Pistia* by means of sodium arsenite or their removal by boats.

The logical control is to destroy the habitat. This may be costly and prolonged, and perhaps prohibitive where large numbers of bayous, ponds, cut-offs, etc., exist. If *Anopheles* alone are to be controlled, spraying with a phenol-resin soap emulsion every six days will probably be all that is necessary. It may even be effective against the *Mansonia*.

Macfie (1917) goes into great detail in his discussion of the favourable oxygen factor in this *Pistia* habitat and relates experiments made with certain mosquito larvae which corroborate his contentions. That this exchange of gases is a favourable one is quite certain. Our common *Anopheles* have been known to stay on the bottom for five minutes; if through the presence of green plants they have a more favourable habitat, then it follows that not only may cutaneous respiration be much more prolonged, but the general death-rate among the larvae may be greatly reduced. This death-rate is reduced also because the leaves of the plants protect the larvae from the numerous swimming enemies in the water, and from the hot, direct rays of the tropical sun.

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LIST OF THE ANOPHELINES OF THE MALAY ARCHIPELAGO WITH SPECIAL REFERENCE TO ADULTS AND LARVAE OF NEW OR INCOMPLETELY DESCRIBED SPECIES OR VARIETIES.

By N. H. Swellengrebel, Ph.D. and J. M. H. Swellengrebel de Graaf.

The following species and varieties have been found in the Malay Archipelago* :—

Myzomyia: ludlowi, rossii, vaga (indefinita), flava, minima, minima var. aconita.

Neomyzomyia: leucosphyra, punctulata var. tesselata.

Cellia: kochi.

Myzorhynchus: sinensis, sinensis var. vanus and var. separatus, barbirostris, barbirostris var. pallidus, albotaeniatus, mauritianus, umbrosus, gigas.

Nyssorhynchus: fuliginosus, maculatus, schüffneri, karwari, jamesi, annulipes var. moluccensis.

Stethomyia: aitkenii, aitkenii var. insulae-florum and var. papuae.

Comparison with the neighbouring Malay Peninsula shows the Anopheline fauna to be almost identical in the two countries. The exceptions are :— *M. aurirostris*, *P. watsoni*, *M. sinensis* var. *peditaeniatus*, *M. albotaeniatus* var. *montanus*, *M. pseudumbrosus*, *M. hunteri* and *L. asiatica*, which are not found in the Archipelago; whereas the Peninsula lacks *M. mauritianus*, *M. gigas*, *M. barbirostris* var. *pallidus*, *S. aitkenii* var. *insulae-florum* and var. *papuae*, and *N. annulipes* var. *moluccensis*.

I.—Description of New Species and Varieties.

1. **Myzomyia immaculata,** Theo.

Myzomyia flava, Swellengrebel (1917).†

A yellow mosquito, with light orange-coloured unbanded legs, creamy unbanded palpi, brownish yellow proboscis and creamy wing scales. Wings unspotted.

♀. Head scaled like *M. rossii*, on the occiput broadly expanding upright forked scales, all scales creamy. Palpi unbanded, creamy. Proboscis brownish yellow, labella yellow. *Thorax*: prothoracic lobes with brownish yellow hairs. Mesonotum with hair-like scales, narrow curved ones in front and a few at the sides, all scales creamy. Scutellum with dark yellow hairs and creamy hair-like scales. Halteres

* Contrary to the present custom we adhere (with a few exceptions) to Theobald's nomenclature, not because we attach to his "genera" any intrinsic value as indicating a really existing relationship, but because the division of the Anophelines into genera is a practical measure, expressing the idea present in the mind of every one who studies these insects in nature, that, *e.g.*, *M. sinensis* is quite distinct from *M. aconita*, but closely allied to *M. barbirostris*, and that *S. aitkenii* is something apart from all other Anophelines. By calling all these species "*Anopheles*" one simply causes confusion and not simplification.

† [On a recent visit to England Dr. Swellengrebel presented to the British Museum a ♂ and ♀ of his *Myzomyia flava*. On comparing the latter with the type of Theobald's *A. immaculatus* both he and Mr. F. W. Edwards concluded that they were conspecific. The older name *immaculatus* must therefore be used for this interesting and little known form.—Ed.]

creamy, light brown at the curve. *Abdomen* with golden hairs, narrow curved golden scales on genital lobes. *Legs* unbanded, light orange. Ungues equal and simple. *Wings* unspotted; scales narrow, creamy or light yellow. Base of 1st submarginal cell nearer the wing base than that of 2nd posterior; the cell is longer than its stem, 2nd posterior cell shorter than its stem. Supernumerary and anterior cross-veins meeting, the posterior one more than twice its length from the latter; 3rd longitudinal vein not ending at the meeting of the supernumerary and anterior cross-veins. *Length*, 4–5 mm.

♂. Like ♀. Club-shaped end of palpi yellow, owing to the presence of long yellow hairs mixed with the creamy scales; a dark narrow band caused by partial desquamation. Narrow-curved creamy scales on the two apical abdominal segments. On the wing, anterior cross-vein situated basally from the supernumerary. *Larva* unknown.

JAVA: Soerabaia. SUMATRA: Mandailing.

Rare. Described from 3 ♀♀ and 3 ♂♂ taken at Soerabaia, June 1917. Easily distinguished from other unspotted Anophelines by the long palps (*M. brevipalpis*) and the broadly expanding upright forked scales on the head (*S. aitkenii*). The species may perhaps be an albinoid variety of *M. vaga* (*indefinita*), as this species sometimes shows a marked decrease of the black portions on the wings and palpi.

2. **Nyssorhynchus annulipes** var. **moluccensis,** Swell. (1920).

A rather large brown mosquito, with spotted legs, 4-5 light bands on palpi, the apex of the 2nd joint being black; proboscis dark, except labella; narrow curved scales on the whole dorsal surface of the mesonotum; wings much spotted, resembling those of *N. punctulata* var. *tesselata*.

♀. *Head* scaled as in other *Nyssorhynchi*. Antennae light brown, basal segment with small white scales, verticils and tomentum golden. Proboscis dark brown,

Fig. 1. Palpi of *Nyssorhynchus annulipes* var. *moluccensis* ♀, three variations.

labella lighter. Palpi (fig. 1): 1st joint black with creamy apex and sometimes a dorsal yellow spot in the middle; 2nd joint black, with a broad white band on apical half and a narrow yellow one at the apex, sometimes a yellow dorsal spot in the middle of the black basal portion, the sub-apical white band sometimes narrow or even absent; penultimate and terminal joints with a narrow black basal band, then a narrow yellow band, the remaining portion creamy. *Thorax*: prothoracic lobes blackish brown, with black chaetae and a tuft of black scales in front. Mesonotum with a dark spot to the right and left at one-third from the anterior border and one in front of scutellum, covered all over with narrow curved white scales,

which also are present on scutellum. Pleurae dark, with a few narrow curved white scales. Metanotum light brown, with a dark median line. Halteres white, with the knob dark at the apex. *Abdomen* dark brown; on apex of 6th and 7th segments narrow curved golden scales, on 8th black ones likewise. *Legs* dark brown with white spots, many of them forming incomplete rings; 1st tarsal joint banded apically, 2nd–4th at both ends (except in hind legs, which have an apical band only); 5th banded at both ends in front legs, unbanded in the others, in front and mid-legs this joint is white on one side. A sub-apical elongated light spot on the tibiae of front legs. Coxae yellowish brown, with narrow white scales. *Wings* (fig. 2):

Fig. 2. Wing of *N. annulipes* var. *moluccensis*, ♀.

on the costa from base to apex 3 short and 4 long black spots and a short one between the 1st and 2nd long spots, these last three extending on to the sub-costa. The 1st–4th long costal spots extend on to the 1st longitudinal in the form of 2, 3–4, 3–4, small spots and one long one; moreover a small spot below the interval of the 1st and 2nd and the 2nd and 3rd costal long spots, and 1–3 at the base. Other small spots are present as follows:—3–5 on upper branch, 5–7 on lower branch, 2–4 on stem of 2nd vein; 5–6 on 3rd vein; 2 apically, one longer basally on upper branch, 2–3 on lower branch of 4th vein, on its stem below the cross-veins a long one, above them 2 long or 1 long and 2 short ones; 4 on the upper branch and lower one, 3 on the stem of the 5th vein; 5–6 on the 6th vein. Fringe dark with bright incisions at the tips of the veins and upward from the 3rd longitudinal vein, except a narrow black spot between the branches of the 2nd vein. Length of 1st submarginal cell more than twice that of stem, its base situated basally from that of 2nd posterior cell. Supernumerary and anterior cross-veins almost meeting, posterior one twice its length from anterior.

Length, 4–5·5 mm.

♂. Palpi: 1st joint black, mixed with white on one side; articulation with 2nd joint light, owing to absence of scales; 2nd joint with one side of basal half and top white, the latter white portion fringed with yellow. Club-shaped end white, black on one side, with basal and median black ring, separated from the white by a yellow margin. *Length* 5–6 mm.

Moluccas. New Guinea.

Described from 5♀♀ and 3♂♂.

Larva (fig. 3). Length 5 mm. Colour greenish brown or dark greyish-green; head brown, with dark bands and spots; white spots on thorax in front and on abdominal segments iii and vii or iii and vi-viii. Antennae without branched hair. Median clypeal hairs far apart, with a few short hairs; external clypeal hairs often nearly as long as medians, with long hairs; posterior clypeal hairs as far apart as medians, reaching to the base of the latter, unbranched or with 2–3 branches.

External occipital hairs with 4 branches, internal ones with 3 branches or simple. A pair of small fans* on thorax, with 10–14 leaflets, sometimes pigmented, no serrate margin. Small fans on abdominal segment i, with 8–16 leaflets, usually serrate, not pigmented. Complete fans on segments ii-vii, with about 18 leaflets, pigmented, serrate near the tip, the latter long and pointed, sometimes ending in a true filament. Shoulder hairs † with thick stem and numerous branches; median and internal one with stout roots which often unite into one.

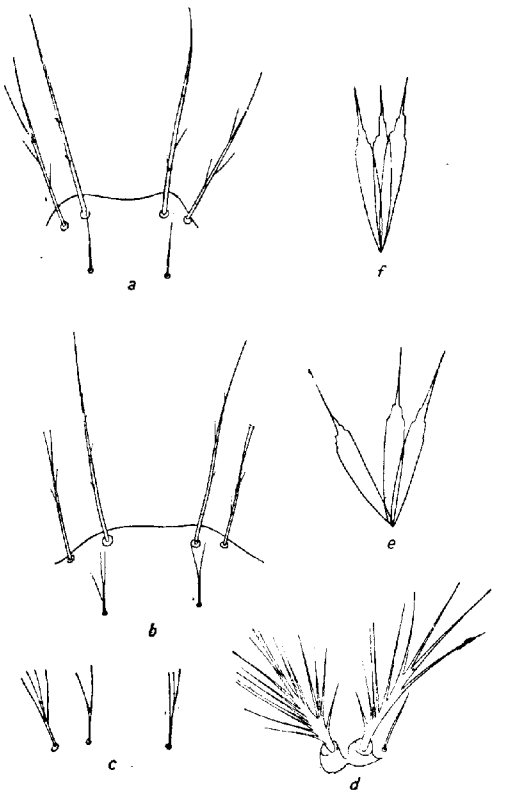

Fig. 3. Larva of *N. annulipes* var. *moluccensis*: *a*, *b*, two types of clypeal hairs; *c*, occipital hairs; *d*, shoulder hairs (right); *e*, *f*, leaflets.

Breeds in all kinds of water, brackish or salt and fresh, running and stagnant, clean and dirty; also in artificial collections of water (coconut-shells, water in native boats).

* Fan = stellate tuft.

† Shoulder hairs = anterior thoracic hairs.

This variety much resembles *N. annulipes*, Walker, as described by Theobald, but the female palpi are different in the latter, the apical half of the 2nd joint being all white. Also, there is a marked likeness to *N. punctulata*, Dön., but the proboscis of this species has a light apical half and the black apical ring of the 2nd palpal joint is much narrower.

3. **Stethomyia aitkenii** var. **insulae-florum,** Swell. (1920).

The imago is not to be distinguished from *S. aitkenii*.

Larva (fig. 4). Length 5 mm. Colour dark green. Antenna with small branched hair. Median clypeal hairs close together, simple, nude; external clypeal hairs simple, nude, length $\frac{1}{3}$ of median ones; posterior clypeal hairs far apart, short, with 3–6 branches; occipital hairs with 3–6 branches. Shoulder hairs with only the median one inserted on a strong root, carrying about 11 branches, the internal one with about 8. Small fans on thorax and abdominal segment i, carrying 13–15

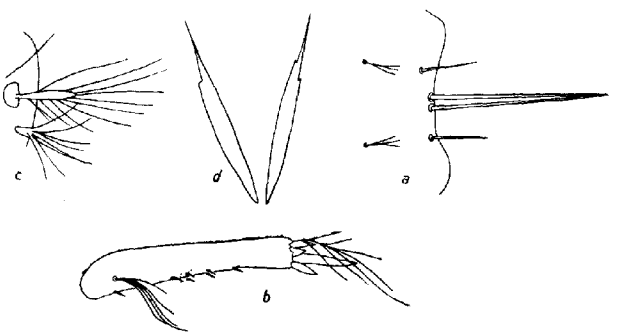

Fig. 4. Larva of *Stethomyia aitkenii* var. *insulae-florum*: *a*, clypeus; *b*, antenna; *c*, shoulder hairs (left); *d*, leaflets.

non-serrate leaflets; segments ii-vii with complete fans, the leaflets very indistinctly serrate, ending in a long point, no filaments.

Breeds in running water in the weeds along the edges, in hilly regions. With the variety *papuae* it is the only representative of this species in the Australian region of the Archipelago. Only once has it been found in Java (Island of Noesa Kembangan on the South Coast).

The larva is somewhat like that of *S. culiciformis*, James, but the club-shaped antennal hair is wanting and the balancing hairs on abdominal segments i-iii are of the usual type and number.

4. **Stethomyia aitkenii** var. **papuae,** Swell. (1920).

Although no adults could be bred from this larval variety, we feel sure that it likewise belongs to this species. It much resembles the larvae of the preceding variety, but is separated from it by the fact of the internal shoulder hairs being very small and carrying two branches only. The leaflets of all the fans show no signs of serration.

The larvae described here, were full-grown, the pupal hairs already showing through the integument of the 1st abdominal segment.

Breeds in the same places as the foregoing variety, but was only found in New Guinea (Kokas, Kaimana, May 1919).

4. Myzorhynchus barbirostris var. **pallidus,** nov.

Adult like *M. barbirostris.*

The relation of this variety to its type is the same as that of *M. peditaeniatus*, Leic., to *M. sinensis*, viz., the larvae differ from the typical ones by the external clypeal hairs bearing a smaller number of branches (11–22 against 60 or more in the type) (fig. 5).

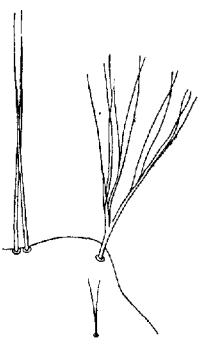

Fig. 5. Larva of *Myzorhynchus barbirostris* var. *pallidus*, right half of clypeus.

Breeds in slowly running water, in springs in the jungle and in rice-fields, but always in hilly country. It is rare in Java and Sumatra; in the Australian portion of the Archipelago it is as common as the typical form.

II. Larvae of known Species not yet or incompletely described.

1. Myzorhynchus albotaeniatus (fig. 6).

Length 5–5·5 mm. Colour dark rusty brown, lighter on dorsum of 3rd abdominal segment, less conspicuously so on the 6th, the 4th almost black. Antennae more stumpy than in *M. sinensis*, length : breadth : : 1 : 4 (1 : 5 in *sinensis*); a branched hair on antennae, its stem half the length of the hair (in *sinensis* $\frac{1}{6}$–$\frac{1}{7}$), the branches emitted nearly at right angles (in *sinensis* at very sharp angles). Median clypeal pairs simple, nude, the distance between them equal to that separating them from the external clypeal hairs (close together in *sinensis*); external clypeal hairs with 18–24 terminal branches; posterior clypeal hairs short, with 3 branches; occipital hairs with 6–7 branches. Internal shoulder hair very small, with 2–3 short apical branches. Small fans with 12–16 non-serrate leaflets on thorax and abdominal segments i-ii; complete fans on segments iii-vii; leaflets as in *M. sinensis.*

Breeds in slowly running jungle streams with scanty vegetation but much vegetable detritus. Java and Sumatra.

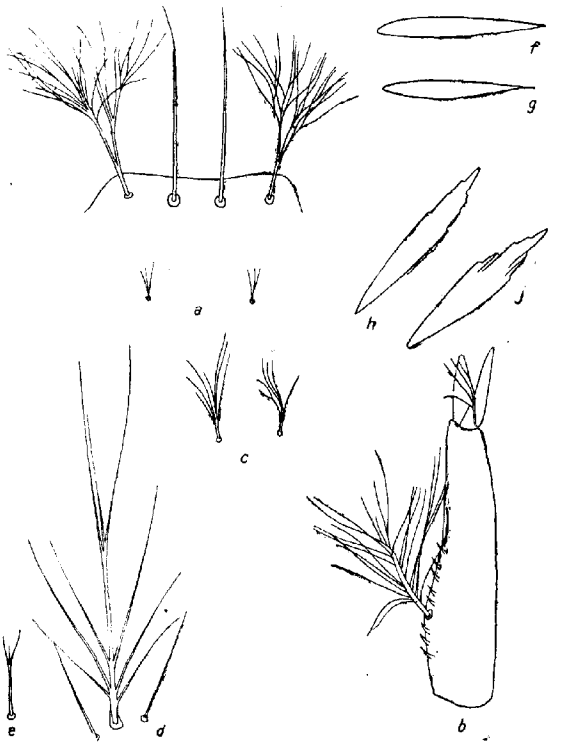

Fig. 6. Larva of *Myzorhynchus albotaeniatus*: *a*, clypeus; *b*, antenna; *c*, occipital hairs; *d*, shoulder hairs (right); *e*, variation of inner shoulder hair; *f*, leaflet, thoracic fan; *g*, leaflet, fan on abdominal segment i; *h*, leaflet, segment iv; *j*, leaflet, segment v.

2. **Neomyzomyia leucosphyra** (fig. 7).

As our own observations differ from those of Stanton (1915) the larva is redescribed here.

Length 4·5–5·5 mm. Colour light yellowish brown or brownish grey. Antennae without branched hair. Median clypeal hairs long and slender, simple, sometimes carrying a few minute hairs; external clypeal hairs nude and simple; posterior ones short, nude, simple; occipital hairs with 2–3 branches. Shoulder hairs usually pigmented, median and internal ones with strong stems, numerous branches and stout roots, often uniting into one. Small fans on thorax, with 10–11 non-serrate leaflets. On abdominal segment i very small fans with 5–7 hair-like leaflets;

on segment ii small fans with 8–11 very narrow leaflets ; on segments iii-vii complete fans with about 18 leaflets each, showing 2–3 indentations near the apex, the latter pointed or rounded, no filament. The leaflets are pigmented throughout.

Breeds in stagnant shady freshwater pools.

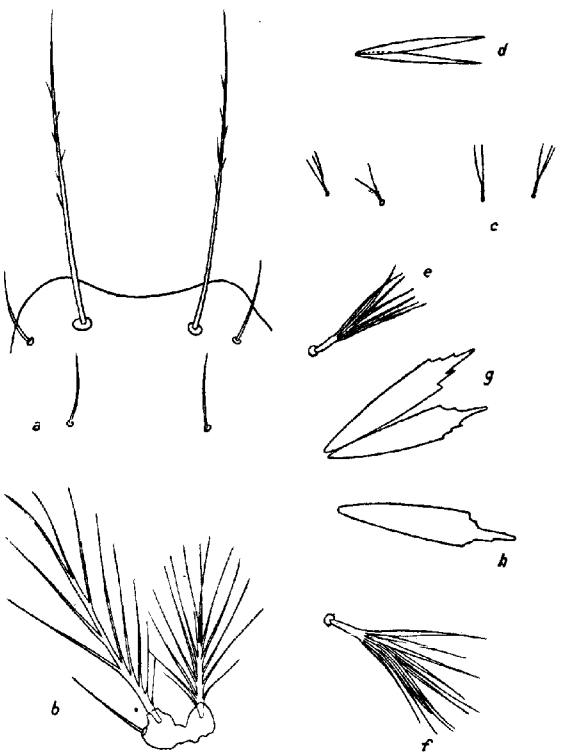

Fig. 7. Larva of *Neomyzomyia leucosphyra*: *a*, clypeus ; *b*, shoulder hairs (left) ; *c*, occipital hairs ; *d*, leaflet of thoracic fan ; *e*, leaflet of fan on abd. segment i ; *f*, leaflet on segment ii ; *g*, leaflet on segment iii ; *h*, leaflet on segment v.

3. **Myzorhynchus umbrosus.**

Addition to Stanton's description.· Another larval type was usually met with in salt or brackish water near the coast, with median clypeal hairs bearing numerous short hairs on the apical half. The adult emerging from this was of the usual *umbrosus* type.

4. **Myzomyia minima** var. **aconita** (fig. 8).

Addition to Stanton's description: In running water a larval type was common with completely nude median and simple long posterior clypeal hairs. The adult emerging from this larval variety showed the usual characteristics of *aconita*. The breeding places of the two larval types differ somewhat: out of 644 typical larvae 42 per cent. were found in rice fields, 11 per cent. in running water, 31 per cent. in fish-ponds, 15 per cent. in marshes and 1 per cent. in dirty stagnant water; the percentages of 562 specimens of the larval variety found in the same breeding-places were 1·7, 88, 10, 0·3 per cent. and nil. Consequently the latter is more adapted to life in running water.

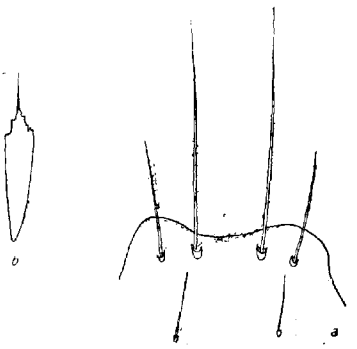

Fig. 8. *Myzomyia minima* var. *aconita*, larval variety: *a*, clypeus; *b*, leaflet of fan on abdominal segment v.

It is to be noted that the larva of the typical *M. minima* (fig. 9) is almost identical with the larval variety of *aconita*, the only difference we could detect existing in the length of the filaments of the leaflets which is $\frac{1}{2}-\frac{3}{8}$ of that of the whole leaflet (in the larval variety of *aconita* this relation is usually $\frac{3}{10}-\frac{2}{5}$).

5. **Differences between the Larvae of Nyssorhynchus punctulata var. tesselata and Cellia kochi.**

Stanton enumerates them as follows: In *N. punctulata* there are no fans on abdominal segments i and ii, whereas in *C. kochi* they are present on the latter. We noted in both species on segments i and ii small fans with very narrow or hair-like leaflets; in *C. kochi* on segment i sometimes a cockade only. Consequently in the Malay Archipelago the fans cannot be used to distinguish these larvae. We use the following characters: In *N. punctulata*: (*a*) Antennae usually much pigmented; (*b*) occipital hairs short with 3 or more branches; (*c*) internal shoulder hairs short, usually with no more than 3 apical branches.

In *C. kochi*: (*a*) Antennae light; (*b*) occipital hairs longer, unbranched or bifurcated; (*c*) internal shoulder hairs long, with numerous long branches inserted at intervals along the stem.

In the Australian region of the Malay Archipelago, a larval variety of *N. punctulata* is commonly met with, bearing fans with non-serrate leaflets, no fans but cockades on the 2nd abdominal segment, and a small fan with hair-like leaflets on the 1st.

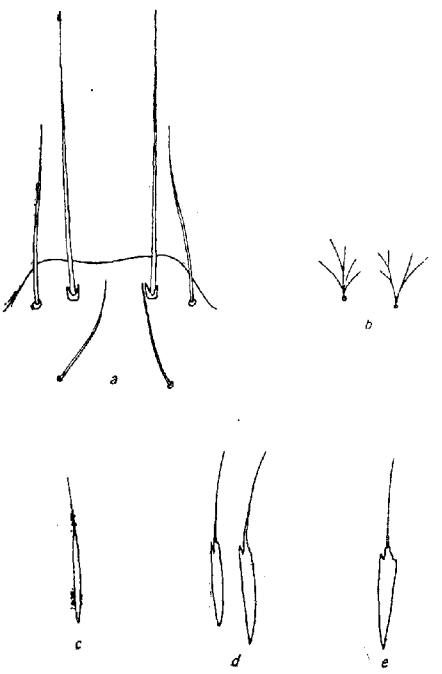

Fig. 9. Larva of *Myzomyia minima*: *a*, clypeus; *b*, occipital hairs (left); *c*, leaflet from fan on abdominal segment i; *d*, leaflet on segment iii; *e*, leaflet on segment vi.

6. **Difference between the Larvae of Myzorhynchus sinensis and M. barbirostris.**

In addition to Stanton's differential characters we noted the following, which however cannot be used if the larvae do not show white spots on the dorsum of the abdomen. But if these are present, they show in *M. sinensis* on abdominal segments iii, v, viii, in *M. barbirostris* on the segments iii and vi–viii but never on v. *N. annulipes* var. *moluccensis* has abdominal spots like *M. barbirostris*.

7. **Abnormal Larvae of Myzorhynchus sinensis and M. barbirostris** (fig. 10).

In both species one of the median clypeal hairs may be placed in close proximity to the neighbouring external clypeal hair, at the same time exhibiting on a shortened

stem a number of long apical branches (10 or more), somewhat resembling the external clypeal hairs of *M. umbrosus*.

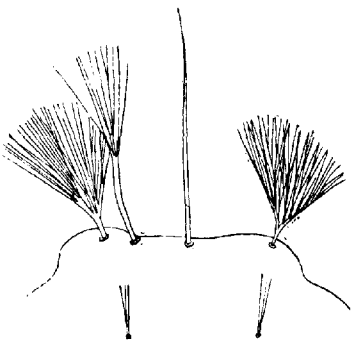

Fig. 10. Abnormal clypeus of larva of *Myzorhynchus sinensis*.

8. **Variations in the larvae of Myzomyia ludlowi and M. rossii.**

As yet we have not succeeded in differentiating these species; in both we have noted the following variations of the mature forms: (*a*) The posterior clypeal hairs are of normal length and bifurcated, or much shorter and trifurcated; (*b*) the median clypeal hairs are bifurcated; (*c*) all clypeal hairs bear 2–5 long apical branches.

These variations are infinitely more common in *M. rossii* than in *M. ludlowi*. Sometimes we found *M. rossii* emerging from larvae resembling those of *M. vaga* (*indefinita*).

9. **Variations of the Larvae of Myzomyia vaga (indefinita).**

We never found *M. vaga* with larvae like *M. ludlowi*, they always adhere to the type first described by Strickland (1915), *viz.*, with the short external and posterior clypeal hairs, the latter placed at a short distance behind the median clypeal hairs and closer together than these. As variations we have noted the bifurcation of the median and posterior clypeal hairs, the latter being placed farther backwards; also they may be placed close together, the one a little in front of the other.

10. **Nyssorhynchus schüffneri** (fig. 11).

The larva was described by Mangkoe Winoto (1918). They are difficult to distinguish from those of *N. fuliginosus*. The following are the characters which separate them: (*a*) the median clypeal hairs bear more and longer branches; (*b*) the posterior clypeal hairs are unbranched or bifid; (*c*) the stems and roots are less thick than in *N. fuliginosus*; (*d*) the filaments of the leaflets on the fans are somewhat shorter than in the same organs of *N. fuliginosus*.

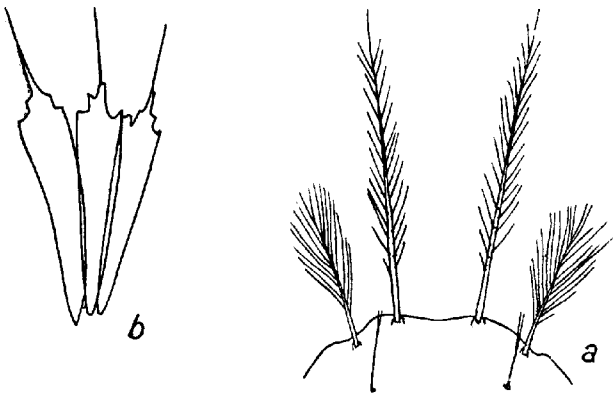

Fig. 11. Larva of *Nyssorhynchus schüffneri*: *a*, clypeus; *b*, leaflet of fan on abdominal segment v.

III. Questions concerning the Validity, Definition and Nomenclature of some Species.

1. Nyssorhynchus fuliginosus var. nivipes.

This variety is characterised by the following points: (*a*) the white area on 2nd joint of the hind tarsus is very extensive, ⅓–½ of the joi... (*b*) wing much lighter, with smaller spots, notably on 3rd vein and upper branch of 5th. The same wing markings are present in the male of the typical *N. fuliginosus*, consequently they cannot be used to separate the males of the type and the variety.

2. Myzomyia minima, and var. aconita.

Christophers (1916) separates these two forms on the grounds that the type (*a*) has the proboscis in the ♀ dark, or with only a light ventral spot near the apex; (*b*) lacks a light fringe spot at the apex of the 6th vein; (*c*) has the apical half of the 6th vein completely dark; (*d*) has a long black spot on the base of the 3rd vein. To this we may add that (*e*) the type shows a broad black band on the middle of the light apex of the palps (in *aconita* this band is narrow). The two forms seem well separated by these characters, but we have met with otherwise typical *aconita* exhibiting the points (*b*) and (*c*), or (*a*), or (*b*) (*c*) (*e*). Moreover, we have found forms with the points (*b*) and (*c*) complete and (*a*), (*d*), (*e*) intermediate; *i.e.*, with a large light patch on the proboscis but ventrally only, a small black patch on the base of the 3rd vein and a band on the apex of the palps in breadth intermediate between that of *minima* and *aconita*. On the other hand, we have observed specimens bearing a spot on the base of the 3rd vein at least equalling in length ½ of the stem of the 1st submarginal cell, but with all the other *minima* characters present likewise.

As we do not think it advisable to throw these two forms together, we propose a purely artificial but easily observable distinction, viz. :—

(*a*) No spot on base of 3rd vein .. .. *M. aconita*, Dön.

(*b*) A small spot present (length about ½ of the 1st submarginal cell), *M. aconita* var. *cohaesa*, Dön.

(*c*) A long spot present (from half as long to as long as this cell).. *minima*, Theo.

3. Myzomyia vaga (indefinita).

The species known under the name of *M. indefinita*, Ludl. (1904) is separated from *M. rossii* by (*a*) a narrow black band at the base of the light apex of the female palpi ; (*b*) a light spot at the apex of the proboscis in the female, behind the labella ; (*c*) a lighter colour ; (*d*) its larger size ; (*e*) the larva. The points (*a*), (*c*) and (*d*) are subject to great variation, (*b*) and (*e*) being constant and reliable ; as (*b*) is not present in the males and (*a*) only refers to the females, the males cannot be distinguished with certainty.

In 1902 Dönitz described under the name *A. vagus* a mosquito distinct from although resembling *M. rossii*. The proboscis of the female is described as being black, with light apex and whitish labella. The palpi of the female are black, the terminal joints white, the penultimate with a broad black band around the base. A distinct variety from Celebes has the penultimate joint of the female palpus white only at the apex. As this is the condition actually existing in *M. rossii* we infer that the specimen on which the species *vagus* was founded had a narrower black palpal band. The species was described from a female caught at Fort de Koch (Sumatra) and we know that no *M. rossii* has ever been found there. From the description of the proboscis and palps of the female (in connection with the description of the variety from Celebes) and the origin of the type we believe that there can hardly be any doubt that Dönitz's *vagus* and the species now called *A. indefinitus* are identical.

Christophers (1916) suggests that Giles' *M. rossii* might be the one with the broad white apex of the palps. As Giles (1900) states that the apical half of the end joint (*i.e.*, of the two terminal joints taken together) is white in the female, we believe this supposition to be not well founded. On the other hand we believe him to be quite right in suggesting that Ludlow's *indefinita* is indeed *M. rossii*, Giles, as she distinctly states (1904) that the palpal markings and general colour of her new species are like those of *M. ludlowi*.

4. Difference between Myzomyia ludlowi and M. rossii.

The following wing marking is very constant and reliable : on the upper branch of the 5th vein, below the cross-veins, both species show two spots, which however in *M. rossii* (and *M. vaga*) are short, whereas in *M. ludlowi* they are much longer. An extensive biometrical research has convinced us that exceptions to this rule are rare (Swellengrebel 1916, Mangkoe Winoto 1918).

5. Neomyzomyia punctulata and N. tesselata (A. deceptor, Dön.).

One of us has shown already that the characters differentiating these two species, so far as they are based on the wing markings, cannot be accepted as valid. Consequently the species are separated only by the palpal markings : in *N. tesselata*

the second palpal joint of the female is white on the apical half, in *N. punctulata* it bears a black sub-apical ring, separated however by a narrow light ring from the basal black ring of the 3rd joint. We do not consider this difference of sufficient value to justify a new species and consequently we rank *N. tesselata* as a variety of *N. punctulata*.

Dönitz believed the var. *tesselata* to be peculiar to the western regions of the Malay Archipelago only, but we have found it as far eastward as Ceram (Moluccas). Dönitz's typical *punctulata* we have never met with. The eastern *punctulata* var. *tesselata* differs however from the common western type, (*a*) by the larvae (p. 7.), (*b*) by the light portion of the proboscis being distinctly diminished in size.

6. **Nyssorhynchus schüffneri.**

Christophers (1916) seems to suggest that this species resembles *N. fuliginosus* var. *adiei*, James. It is said to differ from it by the very short ultimate joint of the female palpus. We found the length of this joint to be 11 per cent. of the palpal length, the palpal index being 0·6, consequently it is an orthodactylous mosquito. But there are other, more striking differences. The palps have 3 white bands only (4 in *adiei*), with a long white tip resembling *M. vaga*. The wing, which in the var. *adiei* is like that in *N. fuliginosus* (judging by James' description), is much lighter in *schüffneri*; the black spots on the costa are rather narrow, on 2nd longitudinal vein one small spot under the 3rd costal spot (reckoned from the apex). Stem of 4th longitudinal vein nearly all yellow, so is the 3rd vein (in *adiei* it is black, except for a few minute light spots).

IV. Geographical Distribution.

A considerable portion of the Malay Archipelago has been searched for Anophelines, and although much remains to be done, we wish to draw attention to the following striking features in the geographical distribution of certain species and varieties.

1. **Nyssorhynchus annulipes var. moluccensis.**

Wherever it occurs this is a very common species, breeding everywhere, and so it is difficult to overlook it. Still it has never been found in Sumatra, Java, Borneo, Celebes and the smaller islands of the western portion of the Archipelago, but it is the commonest Anopheline in the Moluccas and New Guinea. It is closely allied to the Australian *N. annulipes* and its distribution is in accordance with other zoological findings, showing the fauna of the eastern Archipelago to be mainly Australian. It is well known that Wallace divided the Archipelago into an Asiatic and an Australian region by a line following the Straits of Macassar and of Lombok. The Anophelines (and with them other animals; *cf.* Weber 1902) do not conform to this scheme, as the Anopheline fauna of Celebes, so far as we know at present, is purely Asiatic.

2. **Nyssorhynchus schüffneri.**

So far as we yet know, this species is confined to the western provinces of Java (Batavia, Bantam) and the neighbouring Lampong districts of South Sumatra, which are separated from the former by the Soenda Strait.

3. **Myzomyia rossii.**

Christophers (1916) states that *M. rossii*, Giles, is the common western form, whilst *M. vaga*, Dön. (*indefinita*, Ludl.) occurs throughout Malaya. To this should be added that *M. rossii* does so likewise, as far as the Moluccas; only in Sumatra it has not been found, up till now.

4. **Myzomyia ludlowi and Myzorhynchus sinensis.**

We failed to find both species east of Celebes. But we know that in districts where *M. ludlowi* usually is of common occurrence, it may be absent for months and even for a whole year (Citroen 1917). As suitable breeding places were present, likewise its common satellite *M. rossii*, we are not sure that *M. ludlowi* is really absent from the Australian regions of the Archipelago.

5. **Stethomyia aitkenii**

The form with the typical larvae—including all variations described by Stanton (1915) and Stickland (1915)—was not found in the Australian region of the Archipelago. The species was represented there by the varieties *insulae-florum* and *papuae*, which in their turn were absent from the western regions, except var. *insulae-florum*, which occurs on the south coast of Java (Island of Noesa Kembangan).

The following table gives a summary of our present knowledge of the distribution of the Anophelines in the Malay Archipelago.

	javanensis	*minimus*	*aconita*	*rossii*	*ludlowi*	*vaga* (*indefinita*)	*punctulata* var. *tess.*	*leucosphyrus*	*kochi*	*sinensis* (all varieties)	*barbirostris*	*barbir.* var. *pallidus*	*albotaeniatus*	*mauritianus*	*umbrosus*	*gigas*	*fuliginosus*	*maculatus*	*schüffneri*	*karwari*	*annulipes* var. *moluccensis*	*jamesi*	*aitkenii*	*aitkenii* (varieties)	*brevipalpus*
Sumatra	+	+	+	—	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	—	—	+	—	—
Java	+	—	+	+	+	+	+	+	+	+	+	+	+	+	+	—	+	+	+	—	—	+	+	+	—
Borneo, incl. findings of Roper (1914) ..	—	—	+	+	+	+	+	+	+	+	+	—	+	—	+	—	—	+	—	—	—	—	—	—	+
Celebes	—	—	—	+	+	+	+	+	—	+	+	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Moluccas and New Guinea	—	—	—	+	—	+	+	—	—	—	+	+	—	—	—	—	—	—	—	—	+	—	—	+	—
Riouw and Linga Archipelagos ..	—	—	—	—	+	—	—	—	+	+	+	—	—	—	+	—	—	+	—	+	—	—	+	—	—

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COLLECTIONS RECEIVED.

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Dr. J. H. Ashworth, F.R.S. :—2 Chironomidae, 16 Culicidae, 6 *Tabanus*, and 17 *Glossina* ; from the Sudan.

Surg.-Comm. E. L. Atkinson :—4 *Tabanus* and 3 larvae of *Musca domestica*.

Mr. E. Ballard, Government Entomologist :—46 Culicidae, 478 other Diptera, 28 Coleoptera, and 47 Rhynchota ; from Madras.

Capt. P. J. Barraud :—49 Culicidae, 29 other Diptera, 8 Hymenoptera, 377 Coleoptera, 36 Lepidoptera, and 45 Rhynchota ; from Palestine.

Mr. G. E. Bodkin, Government Economic Biologist :—6 Tabanidae, 37 other Diptera, 350 Hymenoptera, 34 Coleoptera, 100 Isoptera, 1 species of Coccidae, 51 other Rhynchota, 52 Spiders, 3 Centipedes, and 2 Millipedes ; from British Guiana.

Mr. P. A. Buxton :—14 Trypetidae, 5 Weevils from Cotton, and 1 Bug ; from Mesopotamia.

Mr. J. B. Corporaal, Entomologist to the Algemeen Proefstation :—136 Rhynchota ; from Sumatra.

Division of Entomology, Pretoria :—14 Diptera, 189 Hymenoptera, and 7 Coleoptera ; from South Africa.

Government Entomologist, Sudan :—3 Diptera, 11 Hymenoptera, 10 Lepidoptera, and 5 Rhynchota ; from the Anglo-Egyptian Sudan.

Mr. G. F. Hill, Entomologist, Australian Institute of Tropical Medicine :—125 Culicidae, 13 Tabanidae, 24 other Diptera, 10 Termites, and 5 species of Coccidae ; from Queensland.

Imperial Department of Agriculture, West Indies :—2 Nests of the Wasp, Polistes *annularis* and 6 Moths bred from them ; from Barbados.

Dr. A. Ingram :—87 Culicidae, 1 *Tabanus*, 2 *Glossina*, 15 other Diptera, 1 Moth, 1 Cockroach, and 2 May-flies ; from the Gold Coast.

Mr. Nigel K. Jardine :—73 Parasitic Hymenoptera ; from Ceylon.

Mr. Ll. Lloyd :—Collections of the Tomato Moth, *Polia oleracea*, L., and the Aleurodid, *Asterochiton vaporariorum*, Westw ; from Hertfordshire.

Mr. A. Loveridge, Curator, East Africa and Uganda Natural History Society :—27 Culicidae, 30 Tabanidae, 20 *Glossina*, 344 other Diptera, 37 Dipterous pupa cases, 834 Ants and 37 pupa cases, 6 other Hymenoptera, 1 Caddis-fly, 1 species of Coccidae, 1,497 other Rhynchota, 2 Orthoptera, and 228 Odonata ; from British East Africa and Tanganyika Territory.

Mrs. W. Smith :—66 Culicidae, 6 *Tabanus*, 1 *Glossina*, 50 other Diptera, 21 Hymenoptera, 23 Coleoptera, 2 Lepidoptera, 2 Caddis-flies, 41 Rhynchota, 6 Orthoptera, and 1 Tick ; from the Gold Coast.

Mr. F. V. Theobald :—2 Chalcids (*Pteromalus egregius*, Först.), bred from the Brown-tail Moth ; from Romney, Kent.

Mr. Robert Veitch :—4 Diptera, 2 Hymenoptera, 3 Coleoptera, and 21 Lepidoptera; from Fiji.

Mr. Morris N. Watt :—7 Agromyzid Diptera; from New Zealand.

Wellcome Bureau of Scientific Research :—9 Culicidae, 39 Tabanidae, 1 Hippoboscid, and 23 other Diptera; from Macedonia and Africa.

Mr. C. B. Williams :—17 Scolytidae; from Trinidad.

Mr. Rodney C. Wood :—4 Tabanidae, 1 Hippoboscid, 77 other Diptera, 165 Coleoptera, and 2 Rhynchota; from Nyasaland.

OBSERVATIONS ON COTTON THRIPS IN THE GEZIRA, BLUE NILE PROVINCE, SUDAN, IN 1918–19.

By G. H. CORBETT, B.Sc.

From conversations that the writer has had, it would appear that this thrips (identified by Mr. R. S. Bagnall as *Heliothrips indicus*, Bagn.) has been known on the Gezira cotton for about three years, and is popularly called " dry asal " in contradistinction to the work of the " asal fly " (*Aphis sorghi*, Theo.) The natives have been acquainted with this insect for some time. The reason suggested for the enormous damage done by it is that the cotton is too scattered, and it is stated that if cotton were cultivated in larger blocks, the thrips might be viewed with equanimity.

The cotton land at Barakat for this year (1919–20) has been, as far as possible, prepared in larger areas, and it will be interesting to compare the result of this arrangement with cultivation at Tayiba, where no alteration in grouping has taken place.

Towards the end of October 1918 the thrips attracted serious attention ; by the middle of November the cotton looked " all withered up," but by the middle of December it began to recover. It was not until the beginning of February that work on this insect was commenced—most of it being done in the field whilst preparing a laboratory to conduct experiments under more immediate control. At that time the cotton had practically recovered, in spite of the fact that the thrips was present in large numbers.

In most cases the infested cotton was first noticed on the north side of a " hosa," and this implies that the thrips either came from weeds growing on fallow land on that side, or was brought from a distance by the prevailing wind, and finding cotton and conditions favourable, propagated to such an extent that the immediate study of the bionomics and control of this insect was considered necessary.

The occurrence of this minute insect in enormous numbers caused, during the season 1918–19, a considerable reduction in the yield of cotton, and it must at present be viewed as a great menace to cotton cultivation in the Sudan, though it may prove to be quite local in its attack and occur only spasmodically. In any case, at a very conservative estimate, an average loss of one and a half kantars of cotton per feddan has occurred during the past season on well supervised and cultivated land.

This is the most important pest with which the cultivators of cotton in the Gezira have to contend. On account of its smallness, the rapidity of its spread, and the seeming suddenness of its attack in large numbers, the control of the insect is one which might present very great difficulties. If the thrips is found on cotton when young, it is probably practicable as well as economical to spray ; but on the other hand, if it comes suddenly when the cotton plants are about five months old, the writer considers the policy of spraying doubtful.

The injury caused to the cotton plant is due to the larvae and adults feeding on both the upper and lower surfaces of the leaves. By piercing the epidermis of the leaf and removing the sap, they lower the vitality of the plant. At the points of attack spots are formed which, often running together, produce distinct white streaks

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where the chlorophyll has been removed ; and later, if feeding is continued, the lower surfaces of the leaves acquire a silvery appearance. As the feeding of this insect is prolonged, the leaves become brownish and tough, owing to the efforts of the plant to repair the injury. In severe infestations the leaves wither up and fall to the ground, preventing the young bolls from developing.

Leaves frequently present a distorted appearance, curling inwards, and in the folds the larvae are often abundant. Larvae have been observed neither on the bolls nor in the flowers, but are occasionally seen on the bracts. On plants grown in the laboratory, larvae have been noticed feeding on the stem and root just beneath the surface of the soil. This undoubtedly was due to the leaves drying up and the thrips migrating for food. In no case was the larval stage completed in such situations.

Though this insect was first observed as attacking fully-grown cotton trees, it may be mentioned that the youngest cotton plants are not immune. For egg-laying, preference is shown by the adults for the lower leaves, and then the middle leaves. On young succulent leaves at the upper portion of the plant, the thrips are never so abundant as they are on the much eaten and tough lower leaves.

Habits of the Adult.

The usual mode of progression of the adult is walking, though when disturbed it runs, and frequently takes long quick jumps. Flight has been observed in a number of cases, but this is not general. Emerging from the pupae in the ground, the adult crawls up the stem to the leaves. In breeding cages it has been noticed to climb up the side of the chimney, and when on a level with the leaves to take a leap to the plant ; this motion is aided by the wings.

By far the larger number of the adult thrips feed on and lay their eggs in the tissue of the lower surface of the leaf, and confine their attention for the most part to the lower and then the middle leaves of the plant. Flowers seem to be immune from attack, but larvae have been found on the bracts. Very often the adults are found resting and feeding along the veins of the leaves, but, as a rule, no particular part of the leaf is preferred.

Adults enclosed in vials with plugs of cottonwool die rapidly, but under more natural conditions they have lived for a maximum of fifteen days, though the average works out at five days. The males and females emerge from the pupae about the same time, but there are indications that the pupal stage is slightly longer in the males than in the females.

The female is capable of laying eggs on the second day after emergence. On an average, six eggs each day are laid in the tissue of any part of the leaf, but though eggs have not been observed, the hatching larvae are more usually found along the veins.

Habits of the Larva.

The young larva, on hatching, looks like a starchy-coloured segmented worm, with red eyes and with no indications of legs or antennae. Gradually it works itself out of the leaf by a slight swaying motion, and standing as it were on its anal segment, unfolds antennae and legs. Later, bringing its legs to the leaf surface, it pulls itself free.

Sometimes it moves only two or three centimetres, but at other times greater distances, before commencing to feed. As it imbibes the sap of the plant, the body takes on a yellowish hue, and usually by the second day the reddish bands, so very characteristic of all stages except the adult, begin to develop. Only one moult has been observed—the change from the larva to the prepupa in the soil.

Like the adult, the larva feeds by piercing and sucking the juices of the plant. It prefers the lower surface of the leaf, though it does not by any means confine itself there. Movement from one surface of the leaf to the other is common, but from one leaf to another is exceptional. Larvae are often found segregated along the veins of the leaf, and occasionally in colonies on other parts of the leaf.

Like many species of thrips, the larva carries a globule of brownish black excreta (on the first day the excreta are colourless), which, after attaining a considerable size and dropping on the leaf, dries to a blackish spot. These spots discolour the leaf, and their presence is a sure indication that the plant has been, or is being, attacked by the thrips. This globule of excreta is held off the surface of the leaf owing to the anal segments of the larva being slightly turned upwards.

The larvae when full grown drop from the leaf, and, crawling into a convenient crack in the soil, there change to prepupae. They prefer damp earth, and the prepupae are usually found at the junction of the damp and dry soil, which varies from about three to six inches down. Immature larvae falling to the ground will die if they cannot find food in the nature of weeds or crawl back to the plant, a very doubtful possibility. It may be noted that practically all weeds growing amongst the cotton support larvae. If the land is kept clean whilst the cotton crop is growing, this will not only prevent the larvae from maturing, but will make the adults seek other plants for oviposition. According to experiments, the adults do not live more than a day without food.

The larvae usually like to secrete themselves away from the sun, and are often found in large numbers in the curled up parts of the leaf. Larvae in the soil do not feed, and, if disturbed, move more quickly than on the leaf.

Habits of the Prepupa and Pupa.

The prepupae and pupae are found in the soil, though under unnatural conditions they have been observed on four occasions on the leaves. This peculiarity was not seen in the field. The larva, before prepupating, does not appear to make any cell, but crawls into any convenient place in the soil. The cast skins of the larvae and prepupae are found together, indicating that no movement of prepupae and pupae takes place. Both stages are capable of movement when disturbed, and are often seen in groups, and at other times singly or in pairs. The want of moisture in the soil does not have any deleterious effect, but from experiments and observations it would appear that if, after the larvae have crawled into the soil, the soil is kept moist and not allowed to crack, the adult is unable to emerge.

The prepupae and pupae possess red bands like those of the larvae; but whilst in the prepupae the antennae are carried forward in front of the head and the wing-lobes are partially formed, the antennae of the pupae are bent backwards over the head and the wing-lobes are well developed. The darkening of the body of the pupae previous to the emergence of the adults is very evident.

Food-Plants.

This thrips seems to feed on most plants, cultivated or wild, and below is a list of the plants on which the larvae have been observed. In course of time, no doubt, other plants will be found to sustain this insect, and attention may be called to the wide range of botanical orders represented in the list. Mr. R. E. Massey, Government Botanist, kindly identified most of the wild plants.

Cultivated Plants.

Potatoes, field beans, French beans, butter beans, ground-nuts, wheat, barley, peas, turnips, cabbages, cowpeas, bamia, beetroot, sweet potato, lettuce, carrot, clover and cotton, both American and Egyptian.

It has been reported as attacking Lubia (Lubia afin) and Dura, but this the writer has not been able to confirm.

American cotton suffers very much more than the Egyptian, and whilst Eygptian cotton recovers remarkably after a severe infestation, in the American variety the percentage of recovery is much smaller.

Wild Plants.

Malata, the most common plant in the Gezira, generally found with thrips.

Leucas nubica, Benth. (ungalot); very common, and always supporting thrips.

Phyllanthus niruri, Linn.

Tephrosia emeroides, Linn. (surep).

Cucumis melo, Linn.

Corchorus olitorius Linn. (molokhia).

Digera arvensis, Forsk. (heyrayrah).

Solanum incanum, L nn. (gibbein).

Ipomoea cordofana, Choisy (hantut or tubba).

Heliotropium europaeum, Linn.

Heliotropium supinum, Linn.

Ocimum basilicum, Linn. (rihan).

Polygala triflora, Linn.

Crotalaria sp.

Abutilon sp. (hambook).

Abutilon sp. (saphirah).

Rhyncosia memnonia, Linn. (myoda).

The local native names for most of the weeds are given in brackets.

Life-Cycle.

Observations were made on this insect only from the month of November to the beginning of August. It is doubtful if there is any aestivating period, and the writer is inclined to think that there is no resting stage though, after the rains commenced considerable search was needed to find specimens of the insect. The differences in the lengths of each stage are remarkable, but under absolute field conditions the life-cycle is a short one, and the thrips quickly reproduce in large numbers.

As the result of a number of observations and experiments it was found that the length of the egg stage varied from 4 to 15 days, with an average of 8·2. In February the minimum and maximum were, respectively, 9 and 15 days; in March, 6 and 11; and in April, 4 and 9.

The period during which the larva remained on the plant varied from 3 to 6 days, with an average of 4·2. From 4 to 14 days elapsed between the entrance of larvae into the soil and the emergence of the adults, the greatest number of emergences taking place on the sixth day.

From this it will be seen that the developmental cycle may be as short as 11 days, or may take as long as 35 days; but the writer is of opinion that 18 days may be regarded as the usual time, and the adults do not begin egg-laying until two days after their emergence from the soil.

Control Measures.

In discussing the control of this thrips, it should be borne in mind that its behaviour after the old cotton crop is removed till the new one is well advanced is not yet precisely known. Larvae were difficult to find on wild plants at the beginning of August, but until the rains commenced they were numerous.

Control may be considered under three heads, namely, suggestions, cultural methods, and insecticide applications.

1. *Suggestions.*

(*a*). If this insect spends the "dead season" on vegetation, all plants of every description should be removed; but if, on the other hand, it rests in the soil, the ploughing of the old cotton land should take place as soon as convenient so as to expose the aestivating stage.

(*b*). Larvae and adults are very numerous on the last standing cotton, and the writer suggests that, since there is so little to be gained and so much to lose, the watering of the cotton should cease slightly earlier and the cotton should be cut out and burnt sooner; by this means the number of thrips that could attack the succeeding cotton crop would be greatly diminished.

(*c*). Observations tend to show that heavy waterings have a detrimental effect on the numbers of thrips emerging from the soil. The probable reason for this is to be found in the fact that the soil does not crack so quickly, and the adults, unable to escape from the ground, succumb. The effect of irrigation on this thrips is a line on which further investigations are required. It is suggested that one or two heavy waterings about the beginning of November might have a very beneficial effect.

(*d*). Owing to the wide range of food-plants, experiments with trap crops should be tried.

2. *Cultural Methods.*

The cultivators of cotton in the Gezira appreciate the extent of the damage this insect can do, and the destruction of all weeds should be the first preventive measure to be adopted. Practically every plant in the vicinity of cotton has been found to harbour the larvae, and all vegetation growing amongst the cotton or in its vicinity should therefore be eradicated. This not only applies to the growing season, but is equally applicable to land which will be under cotton the following year, and to the banks of all canals and gadwels.

It should always be borne in mind that clean cultivation not only prevents, in many cases, the completion of the life-history of this insect, but also yields other advantages to the crops.

3. *Insecticide Applications.*

Four insecticides were experimented with, namely, pyridine sulphate, quinoline sulphate, nicotine sulphate, and soap.

Pyridine sulphate was found unsuccessful.

Quinoline sulphate possesses insecticidal properties, but the fact that it had to be used in strong solution, and therefore in large quantities, rendered it unsuitable.

Nicotine sulphate was tried with soap (" Sunlight ") in varying strengths, and the best solution found was one part of 32 per cent. nicotine sulphate to 1,200 parts of the soap solution, which was obtained by dissolving 1 lb. of the soap in 21 gallons of water.

Soap ("Sunlight") spray, consisting of one pound of soap to ten gallons of water, will kill a large percentage of thrips, both larvae and adults. Soap alone is only recommended if nicotine sulphate is unobtainable.

It should be stated that spraying is considered impracticable, as well as uneconomical, when the cotton is four or five months old ; but if the thrips should appear when the plant is small, the nicotine sulphate spray with soap will be found very useful. Spraying should be done in the late afternoon and evening, and at least twice, so as to kill the larvae which have hatched from eggs in the leaves since the first spraying.

SOME FURTHER NOTES ON THE TSETSE-FLIES OF NYASALAND.

By W. A. Lamborn, M.R.C.S., L.R.C.P.

Glossina morsitans.

A fortunate stay of a few days in July 1919 at Fort Johnston, Lake Nyasa, while waiting instructions, enabled the writer to proceed to the village of Mzeze near the Livingstonia Peninsula, where in 1914–15 some work was carried out on the various insects parasitic on the puparia of this fly.

The success at that time of the various parasites, especially *Mutilla glossinae*, Turner, as judged by the numbers of their cocoons found in old puparia of the fly and bred from recent ones, had been phenomenal, and so the chance, though one lasting only a few hours, of ascertaining the progress made by these insects in the course of the three subsequent years was a very welcome one.

The early rainy season was quite similar in character to that of 1915, when long series of the flies had readily been captured in the district, on passing through which one had been constantly harassed by a buzzing swarm. Far different was one's present experience, for though the journey was made on a cycle, which attracts more flies than a pedestrian, none at all appeared, and it was only on the following day that a single specimen was taken in the course of a hunt for puparia. Local natives agreed as to the diminution in numbers of the flies thereabouts without there being any falling off of game, and added that the pests had now become more numerous to the north, a statement substantiated by personal experience a few weeks later on.

A gang of six boys, who had on a previous occasion worked as puparia collectors and were therefore experts, were got together to assist again in collecting puparia, and the results were confirmatory ; for though two days were devoted to the search, only 107 old puparia and 15 new ones were forthcoming, mostly from the artificial breeding places designed in 1915. Examination of the old puparia showed that nine definitely had been destroyed by Mutillid parasites, but it was not possible to determine with certainty the full extent of the parasitism either by this species or others, owing to the age and broken condition of many of the puparia. Of the fifteen new puparia three only afforded flies, a male on 23rd August, a female on 1st September, and another female on the 4th. Five yielded *Mutilla glossinae*, two males on 17th September, one male on 18th, and one of each sex as long after as 29th. The remaining puparia all died, possibly as a result of the vicissitudes of temperature to which they were exposed, for they were taken on a month's foot journey in the uplands of Angoniland, at an average elevation of from 3,000 to 4,000 feet, hot days being generally succeeded by chilly nights.

Whereas in 1915 at Mzeze parasites would be readily obtained, at Domira Bay none at all were either captured or bred out, this being about fifty miles to the north and separated from the Mzeze area by the south-west arm of Lake Nyasa. No opportunity of visiting the area at Domira Bay occurred, but in September 1919 a visit was made to another section of it, at Kotakota, about forty miles north of Domira Bay, where between the 6th and 10th of the month hundreds of old *G. morsitans* puparia, and sixty-five new ones were obtained. None of these old pupa-cases showed the Mutillid cocoons, nor did any of these parasites emerge from

the new puparia, of which twenty-six yielded flies (twelve males and fourteen females) during late September and the first week of October, the remainder dying.

The *morsitans* area in the neighbourhood of the Livingstonia Peninsula and running inland for miles, so as probably to be continuous with the great area running down the west bank of the bed of the former Shire River, had undoubtedly been infested with these flies for many years, various natives, well on in years, stating that they remember them even when they were children; whereas the area running from Domira Bay up north to Kotakota, and beyond it, and south towards Dedza, in which the fly is far more abundant, has undoubtedly been more recently occupied by them; for many of the younger Government officials remember when large herds of cattle grazed on its wide dambos, now entirely destitute of all domestic animals, though there are large settlements of natives. The evidence would seem to suggest that the abundance of the fly thereabouts may be due to the failure of the natural parasites to keep equal pace with the fly in the migration which has occurred.

Glossina brevipalpis.

This species was found by the writer in the same area with *morsitans* in the course of a journey through a stretch of twenty miles of country between the mouth of the Bua River, twelve miles north of Kotakota, and that of the Duangwa, in every ravine and hollow where large shade trees were associated with heavy undergrowth. As showing how readily the presence of this fly may be overlooked it may be remarked that on the outward journey not one was seen, and that it was only on the return that the capture of two males in the early morning suggested a search. Many were then taken at dusk, and the numbers of the puparia obtained will show how numerous the flies really must have been.

On the 12th of the month a systematic search for their breeding places was commenced. A little scratching with a bit of stick in the loose sandy soil, much lightened by humus, among the herbaceous vegetation beneath a huge shade tree soon brought to light twenty pupa-cases; more were found during the pitching of the tent, and a gang of raw natives who had been attentive to the mode of search were then put to the work. Within four hours the most industrious man had got together 390 puparia (old and new), two others bringing in 267 and 257 respectively, and between the 12th and 15th a total of no less than 13,838 old puparia, with 248 new ones, were found by them. At the same time in these breeding places only 23 puparia (17 old and 6 new) of *G. morsitans* were found, showing how different are the breeding places selected, for *morsitans* was present in swarms.

Twelve of the old puparia of *G. brevipalpis* were whole except for a small puncture which had probably given exit to parasites, though neither on this occasion, nor when the puparia were previously studied, were any of these obtained. The perforations were of two kinds, one about the size of the head of a small pin and situated usually midway between the two poles, and the other a much larger breach less regularly rounded and more commonly towards one or other pole. Twenty-eight only of the new puparia yielded flies (13 males and 15 females), and all the rest perished. All these flies came out an hour or two before dusk, except five, all males which emerged, four at about 10 a.m., one at 2 p.m.

On two successive nights camp was pitched in localities where these pupae were being obtained with a view to ascertaining whether *brevipalpis* is nocturnal as well as crepuscular in its habits. Though 32, all males, were taken at dusk, between 6 and 6.15 p.m., all within 50 yards of the tent, two only were taken inside it. None were taken after dusk, though the nights were bright and starlit, nor were they attracted to the camp lamps. At about 8 p.m. a search was made in the bush by the light of a bullseye lantern, but again the flies were neither seen nor heard; and though the party of 23 natives slept out in the open, few having blankets, none complained of having been troubled by the fly.

The breeding grounds of this fly were further studied in October, some two hundred miles north in the vicinity of the Lufira River, North Nyasa, close to the Lake, a locality long notorious for the fly, the places selected by it having the same character as all the breeding places previously examined. In this neighbourhood 13 new puparia and 9,094 old ones were collected between the 7th and 18th of the month, only 14 of which showed perforations suggesting the exit of parasites.

In the course of the journey through the fly-infested villages north of Kotakota the method was witnessed by which the natives of that part, while sitting down, catch, with the least effort to themselves, flies settled within reach on their bodies. The blade of an old sheath-knife or an old spear blade is placed almost flat on the skin and is then advanced, with the edge slightly raised, by no means slowly or even very carefully, towards the fly, which, though very alert in regard to menace from above, evinces no apprehension of that below it. When the edge is well over its feet the native presses them on to his skin with it, and the fly, so trapped, is then taken in the fingers and subjected to treatment such as is doubtless considered justifiable by reason of the annoyance it has caused.

Suggestions in regard to Tsetse Control.

One of the most pressing entomological problems at the present day in the British Empire is that of the control of the various species of tsetse-flies. As shown by a number of workers, the parasites destructive to their puparia are not few, at all events in the case of *G. morsitans*, and in some areas these parasites are known to exert a considerable influence in reducing the numbers of the fly. But, generally speaking, no very material reduction, from the point of view of man, would seem to be effected by these agencies; though at this early stage of research in regard to the fly it may perhaps be premature to make any unqualified statement as to their control value. Instances have been recorded where the tsetse-fly in a district has unaccountably diminished without there being any marked diminution in the numbers of the game animals therein. Major E. E. Austen in his "Handbook of the Tsetse-flies" (1911, p. 65) mentions the disappearance of *G. morsitans* from the Victoria Falls, where at one time it abounded. The late Captain F. C. Selous, in his book "African Nature Notes," speaks of the disappearance of the flies at the same time with buffalos from the valley of the central Limpopo and its tributaries, where other game—kudu, zebra, wildebeeste, hartebeeste, impala and bushbuck—continued to exist in considerable numbers, and he suggests that the flies died out because they were unable to maintain themselves on game other than buffaloes. More recent study of the flies has shown that this is not the case, and the writer

suggests that a more reasonable explanation is to be found in the local extermination of the flies by their parasites, a process, as he believes, now steadily proceeding in the area near Mzeze, Nyasaland. The question therefore naturally arises—how far is it possible to increase their influence either by the introduction of new parasites or by breeding on a larger scale those already known to science ?

The genus *Glossina* being now limited to the Ethiopian region, it is doubtful how far the parasites of other Diptera, brought in from other lands, would seek out and destroy its puparia. It is to be apprehended that those obtained from the puparia of other Muscids, breeding under more or less similar conditions, might do so. A more hopeful line of action could possibly be found in the search for other species naturally parasitic on *Glossina* but having a different geographical distribution. For instance a Bombyliid fly, *Villa lloydi*, Austen, parasitic on *G. morsitans*, has so far only been discovered in Rhodesia, and a second species of parasitic Mutillid, *M. benefactrix*, Turner, in Nyasaland only. The parasites of the fly on the West Coast are probably different from those in the East and South, the insect fauna, generally speaking, being largely distinct. The various species of tsetse-flies may each have different parasites yet to be discovered, which might be interchangeable.

It is probable, and some of the evidence on this point is very definite, that in the case of rapid extension of a fly area, parasites less endowed than their hosts with the power of ranging far and wide—strength on the wing having doubtless played a considerable part in the present-day success of the tsetse as an insect—have lagged more or less behind in the foci first inhabited by the flies. And this is particularly likely to be the case with Mutillids, the females of which are wingless. One of the present suggestions in connection with fly control is to endeavour to enhance the value of the parasites already known to science, the Chalcids in particular. They could unquestionably be bred readily enough in the laboratory on the puparia of their natural host, though owing to the difficulty in obtaining these in any numbers, the laboratory output would necessarily be very limited. It has occurred to the writer that it might be possible to employ as alternative hosts the puparia of some of the common Muscids, then liberating in great numbers the little insects, each with its dominant aim in life to seek out and destroy the greatest of the insect scourges of man and beast in the African Tropics.

The general upset of work as a consequence of war conditions made any attempt to put the idea to a practical test impossible, but an opportunity was made to carry out, during 1918 in East Africa and during the last six months of 1919 in Nyasaland, research work in regard to the question of alternative hosts for Chalcids normally parasitic on certain Muscids. The results (which will be written up later) showed some promise, though this work has again, unfortunately, been brought to a premature close.

THE EARLY STAGES OF WEST AFRICAN MOSQUITOS. V.—*CULEX DECENS*, THEO. AND *CULEX INVIDIOSUS*, THEO.

By J. W. S. Macfie and A. Ingram,
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Both *Culex decens* and *Culex invidiosus* are widely distributed in British West Africa. In the Gold Coast both have been taken in all the three divisions into which the country is divided, namely, the Colony proper, Ashanti and the Northern Territories; the records at Accra showing the following distribution :—

Culex decens.

Colony—Accra, Cape Coast Castle.

Ashanti—Kintampo, Kumasi, Sunyani.

Northern Territories—Batiasan, Bawku, Binduri, Bole, Daweni, Dogan Kade, Jefisi, Kalleo, Kpalgu, Lorha, Mayoro, Nandaw, Nandawli, Nasia, Navarro, Pinna, Salaga, Sambolugu, Savelugu, Tamale, Tanina, Tiana, Tishi, Ulu, Wa, Yaga, Zuaragu.

Culex invidiosus.

Colony—Accra, Akuse, Bibianaha, Koforidua, Nsawam, Sekondi.

Ashanti—Akrokerri, Bjere, Kumasi, Obuasi, Odumase, Sunyani.

Northern Territories—Bawku, Bole, Gambaga, Kugri, Lorha, Maliki's Zongo, Navarro, Tumu, Turu, Wa, Zuaragu.

So far as they go these records do not point to any cleavage in the areas of distribution of the two mosquitos, both species having been collected in a number of the same places.

The majority of the records for the Northern Territories were made by one of us (A.I.) during a tour undertaken in 1918, the observations made at this time suggested that *C. decens* might be a domestic variety of *C. invidiosus*. Edwards (Bull. Ent. Res. iii, p. 381), however, considers the two to be distinct. In the adult, he says, "*C. decens* can be distinguished by the reddish thorax (that of *C. invidiosus* being brownish), and (in the male) the banded abdomen. In the female the abdominal banding is not constant; the bands in *C. decens* are always narrow and may sometimes be interrupted." But he failed to detect any differences in the genitalia of the males (an observation which he repeated later, Bull. Ent. Res., v, p. 70), and was unable to separate the larvae, considerations which led him to admit that it was "quite possible that the two are really only forms of one species."

We have compared a number of larvae and pupae of these mosquitos in an endeavour to find some means of distinguishing them. We may say at once that we

were unable to detect in the larvae any constant difference of specific importance, and as this observation is in accord with that of Edwards further details will not be given.

In a previous paper (Bull. Ent. Res. viii, p. 85) we have described the pupa of *C. invidiosus*. The pupa of *C. decens* (= *C. nigrocostalis*, Theo., and *C. lividocostalis*, Graham) has been briefly described by Wesché (Bull. Ent. Res. i, pp. 40 and 45), but the details given are meagre. As it was necessary on this account to re-describe the pupa of *C. decens*, and as it seemed advisable to give at the same time further details regarding *C. invidiosus* because of the very close resemblance of the two pupae, we decided to compare seta by seta five specimens of each. The result of this examination will be recorded here in detail.

The pupae were found to be similar both in their general features and as regards the arrangement of their cephalo-thoracic and abdominal setae. In describing the setae the same method has been adopted as that employed by one of us in describing the pupa of *Stegomyia fasciata* (Bull. Ent. Res. x, pp. 161–172).

General Features.

In Table I the general features of the pupae are tabulated. The figures given are the averages of the measurements made in each case. The specimens of *C. invidiosus* examined were on the whole slightly smaller than those of *C. decens*. It will be observed that the general features of the two pupae were similar.

TABLE I.

General Features of the Pupae of C. decens *and* C. invidiosus.

	C. decens	*C. invidiosus.*
Length of pupa, extended ..	4–4½ mm.	4–4½ mm.
Respiratory trumpet,		
total length	640μ	580μ
length of the open portion (pinna)	170μ	160μ
ratio of the length of the closed portion (meatus) to the total length ..	1 : 1·4	1 : 1·4
Length of the tuft (A) at the posterior angle of the seventh abdominal segment	210μ	190μ
Length of the tuft (A) at the posterior angle of the eighth abdominal segment ..	210μ	190μ
Paddle, length	750μ	740μ
breadth	530μ	530μ
ratio of length to breadth	1·4 : 1	1·4 : 1

Cephalo-thoracic Setae.

The setae on the cephalo-thorax of these pupae are alike, and are similarly situated to those of *Stegomyia fasciata* (loc. cit.); they do not require special description. Details regarding the subdivisions of the cephalo-thoracic setae are furnished in the following comparative table (Table II).

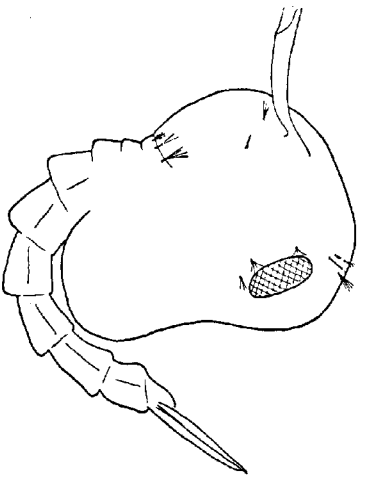

Fig. 1. Diagram showing the arrangement of the setae on the cephalothorax of the pupa of *Culex decens* or *C. invidiosus*.

TABLE II.

A Comparison of the Cephalo-thoracic Setae of the Pupae of C. decens *and* C. invidiosus.

Seta.	*C. decens.*	*C. invidiosus.*
Post-ocular,		
Superior; rather long, not especially strong ..	3	3–4, usually 3
Median; rather long, not especially strong ..	4–5, usually 4	4–5, usually 4
Inferior; rather long, not especially strong ..	3–4	3
Antero-thoracic,		
Lower anterior; moderate length, constituent hairs rather delicate	4–5	4–7
Upper anterior; rather small and delicate ..	1–5	3
Lower posterior; long, but not very strong	2	2–3, usually 2
Upper posterior; rather small and delicate, situated above the lower posterior seta ..	1–4	2–5
Dorsal; moderate length and strength	2–4, usually 4	3–5
Supra-alar; moderate length and strength	2	2–3, usually 2
Postero-thoracic,		
Internal; well-developed tuft of moderate length and strength	5–8	5–8
Median; rather long and strong	2–3, usually 2	2
External; tuft of moderate length and strength, or rather long	3–5	3–5

Dorsal Abdominal Setae.

The setae on the dorsal and lateral aspects of the abdomen may be described together. Details as to the subdivisions of these setae will be found in the tabular statement which follows; the facts given here are either of a general nature, or such as may be required to make the table comprehensible.

The following setae, which form series, are recognisable on each side of a typical segment of either pupa :—

1.—The *lateral seta* (A), situated a little above and internal to the posterior angle.

2.—The seta belonging to the *sub-median row* (C), on the dorsum, situated near the posterior margin of the segment about half way between the posterior angle and the middle line of the abdomen. This is the row of setae which on a previous occasion (Bull. Ent. Res., x, p. 59) was referred to as the *inner lateral row.*

3.—A very small seta (C′), situated near the posterior margin of the segment and a little internal to C.

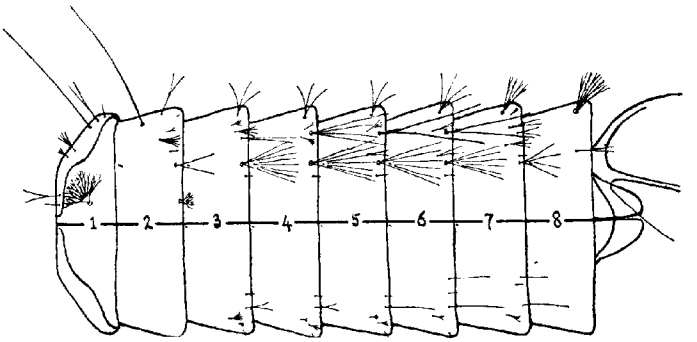

Fig. 2. Diagram showing the arrangement of the setae on the dorsal and ventral aspects of the pupa of *Culex decens* or *C. invidiosus*; dorsal setae shown on the upper, ventral setae on the lower half.

4.—The seta belonging to the *sub-lateral row* (B) on the dorsum, situated near the posterior margin of the segment about half way between the posterior angle and C. This is the row of setae which on a previous occasion (Bull. Ent. Res., x, p. 59) was referred to as the *outer lateral row.*

5.—Two setae (B′ and B″) situated a little anterior to the posterior margin of the segment; B′ outermost and always more or less external to B, B″ internal to B′ and on some segments external, on others internal to B. B″ is sometimes associated more closely with C than with B, for example on the sixth segment.

6.—A very minute seta, the *anterior dorso-central seta* (D), near the anterior margin of the segment in line with the setae of the sub-median row.

These seven setae are easily recognised on the third to the sixth segments; the setae on the other segments do not conform completely to this plan and require a few words of explanation.

Segment I. The setae on this segment are arranged in a similar manner to the corresponding setae of *Stegomyia fasciata*, and the same names are used in describing them, namely, Dendritic tuft for the large branched seta in the middle of the segment near the median line, and, for the setae along the proximal border, from within outwards, Antero-internal, Antero-external, Medio-internal, Medio-external, Postero-internal, Postero-external and Lateral.

Segment II. Nine setae may be seen on this segment in a dorsal view, of which C and D are as defined above. Internal to C, near the posterior margin of the segment, is a small dendritic tuft (D. T.). The setae external to C are as follows: a small single seta (B) a little external and anterior to C, a tuft of moderate size (B″) a little external and anterior to B, and a small tuft (B′) a little external and posterior to B″. Laterally, or ventro-laterally, there are three setae: the most anterior (A′) a very long, stout seta; rather posterior to A′ a seta (A) similar to the Lateral setae on the more posterior segments; and posterior to A a very small seta (S) similar in appearance to the Postero-lateral setae on the ventral aspect of the abdomen.

Segment VII. A, B, B′, B″, C, and D as defined above. There is no small seta internal to C, but a little external to it there is a small seta similar to C′ on the other segments; this seta is referred to in the Table as C′. In addition there is a small tuft (A′) close to and a little posterior to A.

Segment VIII. A and D as defined above. In addition there is a delicate seta (P) situated close to the external margin of the root of the paddle. At the distal end of the midrib of the paddle there are two very small setae (P′ and P″); usually single, but sometimes forked at their ends or even divided more deeply.

TABLE III.

A Comparison of the Dorsal Abdominal Setae of the Pupae of C. decens *and* C. invidiosus.

Segment.	Seta.	*C. decens.*	*C. invidiosus.*
I.	Dendritic tuft; large and well-developed, strong primary branches	8–12	8–11
	Antero-internal; short, rather stout	1, end occasionally forked.	1
	Antero-external; rather long and strong	2–3, usually 2	2
	Medio-internal; small	1, or a small tuft*	1, or a small tuft
	Medio-external; small, but longer than the Medio-internal	Tuft of about 2–5 hairs.	Similar tuft
	Postero-internal; very long, strong	1–2, usually 1	1
	Postero-external; rather long and slender	2	1–3
	Lateral; small, delicate	1, end sometimes divided.	1, end sometimes divided.
II.	A; rather long and slender	2	1–3
	A′; very long, strong	1–2	1–2
	S; very small and feebly chitinised	1	1
	B; small, rather stout	1	1
	B′; small tuft	Small tuft of 2–5 hairs	Similar small tuft
	B″; small tuft, but considerably larger than B′, situated between B and B′ and anterior to them	Tuft of 4–6 hairs	Tuft of 4–6 hairs
	C; moderate length, reaching nearly half way across the third segment	2–3, usually 2	2
	D.T.; small dendritic tuft	Small dendritic tuft	Small dendritic tuft
	D; minute	1	1
III.	A; rather long and slender	2–3	2–4
	B; rather long and strong	2	2
	B′; small tuft between A and B″	Small tuft, 1–7 hairs	Small tuft, 1–4 hairs
	B″; tuft, considerably longer than B′, situated between B and B′	Tuft, 3–7 hairs	Similar tuft

*In the case of small tufts, the number of constituent hairs, when given, is only approximate as it was often impossible to determine with accuracy the degree of sub-division.

Segment.	Seta.	*C. decens.*	*C. invidiosus.*
	C ; well-developed tuft, reaching about half-way across the fourth segment	6–9	6–12
	C′ ; small	1	1
	D ; minute	1	1
IV.	A ; rather long and slender ..	2–4	3–4
	B ; long, strong, reaching almost across the fifth segment ..	3–4	4–6
	B′ ; small tuft, external to B ..	Small tuft, 1–3 hairs	Small tuft, 1–3 hairs
	B″ ; small tuft, anterior to B ..	Small tuft, 4–6 hairs	Small tuft, 4–7 hairs
	C ; well-developed tuft reaching further than half-way across the fifth segment	4–8	6–10
	C′ ; small	1	1
	D ; minute	1	1
V.	A ; rather long and slender	3–4	3–4
	B ; very long and strong, reaching beyond the posterior margin of the sixth segment	2	2
	B′ ; rather small tuft, external to B ..	Small tuft, 2–5 hairs	Small tuft, 2–6 hairs
	B″ ; moderate length, external and anterior to C	1–2, usually 2	2–3, usually 2
	C ; well-developed tuft, reaching further than half-way across the sixth segment	4–8	6–7
	C′ ; small	1	1
	D ; minute	1	1
VI.	A ; rather long and slender.. ..	3–4	3–5
	B ; very long and strong, reaching beyond the posterior margin of the seventh segment	2	2
	B′ ; small tuft, external to B ..	2–4	2–4
	B″ ; moderate length, situated external and anterior to C	2	2
	C ; well-developed tuft, reaching about half-way across the seventh segment	4–7	4–8
	C′ ; small	1	1
	D ; minute	1	1
VII.	A ; constituent hairs strong, usually sub-plumose and often branched, sometimes simple	3–5	2–4
	A′ ; small tuft	Small tuft	Small tuft
	B ; moderate length and strength ..	2	1–3
	B′ ; moderate length, external to B ..	2	2
	B″ ; moderate length, internal to B ..	1–4	2–5
	C ; moderate length, reaching about half-way across the eighth segment	2–5	4–7
	C′ ; small, external to C	1	1
	D ; minute	1	1
VIII.	A ; well-developed tuft, constituent hairs strong, usually branched and sub-plumose	6–7	5–9
	D ; minute	1	1
	P ; moderate length, slender ..	2	2
	P′ and P″ ; very small	Two small setae	Two small setae

Ventral Abdominal Setae.

The setae present on each segment, as well as the characters of the setae, are shown in the following tabular statement (Table IV).

TABLE IV.

A Comparison of the Ventral Abdominal Setae of the Pupae of C. decens *and* C. invidiosus.

Segment.	Seta.	*C. decens.*	*C. invidiosus.*
III.	D ; very small, feebly chitinised ..	1	1
	E ; small tuft, longer than E′ ..	Small tuft, 4–5 hairs	Small tuft, 2–5 hairs
	E′ ; small tuft	Small tuft, 2–5 hairs	Small tuft, 4–5 hairs
	C ; moderate length	2	2
	B′ ; small	1	1
	A ; minute	1	1
IV.	D ; very small, feebly chitinised ..	1	1
	E ; small tuft..	1, or small tuft, 2–5 hairs.	Small tuft, 2–4 hairs
	E′ ; small tuft, longer than E ..	1, or small tuft, 2–6 hairs.	1, or small tuft, 2–4 hairs.
	C ; moderate length	2	2
	B′ ; small	1	1
	A ; minute	1	1
V.	D ; very small, feebly chitinised ..	1	1
	E ; small tuft	1, or small tuft, 2–4 hairs.	Small tuft, 2–4 hairs
	E′ ; small tuft, longer than E ..	Small tuft, 2–5 hairs	Small tuft, 4–7 hairs
	C ; rather long, reaching fully half way across the sixth segment ..	1	1
	B′ ; small	1	1, end sometimes forked.
	A ; minute	1	1
VI.	D ; very small, feebly chitinised ..	1	1
	E ; small	1, or small tuft, 2–4 hairs.	1, or small tuft, 2–3 hairs.
	C ; rather long, reaching fully half way across the seventh segment	1	1
	B ; rather long, shorter than C ..	1	1
	B′ ; small	1–2, usually 1	1–2, usually 1
	A ; minute	1	1
VII.	E ; small tuft	Small tuft, 2–4 hairs	Small tuft, 2–4 hairs
	C ; rather long, reaching fully half way across the eighth segment.	1	1
	B ; moderate length	1	1
	B′ ; small, end sometimes forked or sub-divided, a little external and anterior to B	1–2	1–4, usually 1
	A ; minute	1	1
VIII.	A′ ; minute	1	1

The setae on the ventral aspect of the abdomen are few, and mostly inconspicuous. The following setae, which form series, may be recognised on each side of the abdomen of either pupa on two or more of the segments :—

1.—A small seta, the *medio-lateral seta* (E), a little internal to the lateral border and rather posterior (junction of the posterior and middle thirds) to the middle of the segment.

2.—A very small seta, the *postero-lateral seta* (D), in a lateral position just above the posterior angle.

3.—A small seta (E′) a little posterior and external to E.

4.—The seta belonging to the *inner ventral row* (B).

5.—The seta belonging to the *outer ventral row* (C).

6.—A small seta (B′) near the posterior margin of the segment a little internal to C.

7.—A very minute seta, the *anterior ventro-central seta* (A), at the anterior margin of the segment and very close to the middle line of the abdomen.

Two setae require special mention. On the eighth segment there is a minute seta (A′) near the anterior margin of the segment a little internal to the level of B on the seventh segment. This seta resembles A, but is placed more externally and posteriorly than A on the more anterior segments. On the seventh segment the small seta internal to C is situated close by and a little anterior to B; we have therefore marked it B′, and have retained this symbol for the similar setae on the more anterior segments which, however, are situated nearer the posterior margin and more externally.

It is clear from the descriptions which have just been given that the setae of the pupae of *C. decens* and *C. invidiosus* are similar in character and situation, and that although they are somewhat variable as regards their sub-divisions the degrees of variation of the two overlap. In fact, they provide no feature of differential importance.

The question then arises, are *C. decens* and *C. invidiosus* separate species or are they varieties of a single mosquito. There are indeed certain differences in the adults, but the genitalia of the males are identical according to Edwards, the larvae cannot be separated, and the same remark applies to the pupae. Under these circumstances we think there can be little doubt that they should be regarded as varieties and not as distinct species; we propose to retain for the species the name *C. decens*.

SOME NOTES AND REMARKS ON THE BIONOMICS OF *GLOSSINA MORSITANS*.

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It is with considerable diffidence that the writer has prepared the following paper, not only on account of several previous contributions to the subject, but also, and chiefly, because no opportunity has been available for more than comparatively brief visits to the fly areas in Southern Rhodesia, and the observations to be recorded are therefore of a somewhat meagre nature compared with work that has been carried out of recent years in other parts of Africa. The tsetse-fly problem is, however, of such paramount importance to Africa as a whole, and the continued extension of the fly belts such a grave hindrance to the full development of Southern Rhodesia, that it is felt that too much time and thought cannot be devoted to the subject, and that every contribution whether of actual observations or of theoretical deductions, or of both, must have a certain value, if only in provoking discussion and criticism. In the following pages the important question of whether or not *Glossina morsitans* is vitally dependent upon the larger mammals is not directly dealt with. The strong trend of scientific opinion in the direction of an affirmative conclusion must be admitted at the present day by the most vigorous opponent of the theory. There is hardly an investigator of any standing who has not contributed some observations of weight, indicating that the fly is mainly dependent upon the larger mammals for its food supply. For the purposes of the present discussion this dependence has been to a large extent assumed with a view to an attempt to explain certain phenomena upon this basis. The discussion is, however, of a very disconnected nature and aims merely at touching upon a few points in connection with the bionomics of the fly that need clearing up, and if the writer's views provoke criticism, or even direct contradiction, supported by actual observations, the paper will have served its purpose, as our knowledge of the subject cannot fail to benefit thereby.

It will be found that there is a very substantial agreement between observations in this territory and those recorded further north, particularly in Northern Rhodesia, but there are several important points bearing on the fly problem concerning which a considerable difference of opinion appears to exist, and others that have not apparently been touched upon as yet.

The points raised include:—(1) the conditions in the dry season in respect to the welfare of the fly; (2) the effect of grass burning on the numbers of the fly; (3) the value of mopani country to the fly; (4) the question of migration under the influence of hunger or other stimulus; (5) the question of fly moving about infested areas with game; (6) the distance at which the fly can detect its hosts; (7) the following distance of female flies.

In the following pages it is desired to emphasise the importance of these points, stating the writer's own attitude of mind towards them in the light of available evidence, but without preferring any claim to having reached a final conclusion. Direct investigation of several of the points is planned for early attention if circumstances permit, and it is hoped that other investigators will carry out similar researches so that definite solutions may be reached.

Conditions in the dry Season.

Dr. H. Lyndhurst Duke, of Uganda, in a recent paper* refers to the dry season as a time of stress and reduced breeding rate for the fly in that territory. Lloyd's records concerning Northern Rhodesia are quoted as parallel observations, although the latter's statement to that effect applied only to the earlier part of his work in the Luangwa Valley (Bull. Ent. Res. iii, p. 234) and his later work on the plateau led to exactly the opposite conclusion, namely that breeding was practically confined to the warmer part of the dry season (Bull. Ent. Res. v, p. 58). Lamborn in Nyasaland has made several statements on this point. For instance, in his Third Report on *Glossina* Investigations in Nyasaland (Bull. Ent. Res. vii, pp. 29–50) on page 30 we have the statement: " The small number of living pupae is to be accounted for by *the breeding being at its minimum during the late dry season* " (July). On page 36 he states: " Now as the dry season draws to a close pupae are being produced more freely;" and on page 46, " The breeding season for *G. morsitans* is in full swing, just as the rains are about due." It would seem that the period when the dry season " draws to a close " and " the rains are about due " might without inaccuracy be described as " the late dry season " in preference to July. Nevertheless Lamborn's contention is quite clear, namely that the breeding season is at its minimum in July, and is in full swing in October, when the first rains may be anticipated both in Northern and Southern Rhodesia. In Southern Rhodesia, however, the October rains are normally very local and may not occur at all, and dry season conditions frequently prevail well into November. October and November (before heavy rains set in) are well known as the hottest months of the year and the term " latter part of the dry season " would appear naturally to include the period from the beginning of August to the opening of the heavy " planting " rains, which usually commence about mid-November. In some seasons they are, however, postponed until well into December, and in such circumstances, as the veld still maintains a dry season character, observations on breeding rates, etc., are still influenced by late dry season conditions, and this should be made clear.

Observations on the seasonal breeding rate in Southern Rhodesia are insignificant compared with those in Northern Rhodesia and Nyasaland, owing to the fact that no officer has been available to devote even the bulk of his time to the tsetse-fly problem. There is not the least doubt, however, that the fly may, under favourable conditions, breed very freely during the latter and warmer part of the dry season (August to November). Observations at Sipane Vlei, already published, leave no doubt upon that point. It would seem therefore that conditions in Nyasaland, and Northern and Southern Rhodesia are similar in this respect, at least as regards the plateaux. In Uganda on the other hand the published records of rainfall in the Masindi area and at Mpumu show that the climate is very different, the dry season being much less clearly marked and of much shorter duration.

In 1911 the writer called attention to a marked difference in the distribution of fly in the dry and wet seasons.† The dry season haunts of the fly in Southern Rhodesia have been described more than once. They consist of centres where shady evergreen

*Bull. Ent. Res. x, p. 20, lines 11–13, and elsewhere.

†Bull. Ent. Res. ii, pp. 357–361.

trees exist and apparently correspond more or less to the areas termed "foci," "primary centres," etc., described later in Central and East Africa. These dry season haunts undoubtedly vary to a considerable extent in their efficacy as favourable habitats for the fly, as is indicated by the fact that some of them are intensely and others little infested. The type of dry season haunt where the fly is generally met with in the greatest numbers consists of a vlei, with the necessary evergreen trees along at least some portion of its margin, in a part of the fly area where vleis are scarce. Surface water may be present, or not, but the underground supply is always much nearer the surface than in the surrounding country, with the result that green grass starts growing with the warm weather long before the rains commence. The green grass in the vlei, especially after the dry grass has been burnt off and the young grass has begun to grow, is intensely attractive to grass-feeding animals, which often concentrate in considerable numbers around an isolated spot of this nature and move in regularly during the afternoon to feed, passing perforce through the haunts of the fly in doing so. In this way the flies obtain more or less regular meals and the whole conditions appear to be ideal for rapid increase during the latter part of the dry season, namely, regular food, warm weather and shelter for the larvae and pupae. Such centres might conveniently be termed "first grade foci."

In other parts of the fly areas rivers and vleis are much more prevalent, and intense concentration of both game and fly does not occur. The dry season haunts of the fly correspond, however, with the best grazing grounds at this time of the year, on account of the fact that the superior underground water supply supports both evergreen trees that shelter the fly and green grass that attracts the game. The term "second grade foci" might be permitted in this connection.

In other places again, the fly affects shady forest bordering rivers, streams or dry water-courses, and although not the main grounds, game has a tendency either to lie up in such situations during the day, or to pass through for the purpose of drinking. In the writer's experience, wart-hog, water-buck, kudu, impala and small buck are very commonly found in this type of forest during the daytime, whereas certain types constitute the permanent home of bushbuck. Such spots are rarely heavily infested and may be termed "third grade foci."

It must be borne in mind that animals of all sorts seek the shade during the heat of the day in hot weather, and as the fly is also dependent upon shade, fly and game must in general tend to meet at the time of year when shade is restricted more readily than at other times when shade, water and grass are everywhere to be found. Provided, therefore, that the temperature is suitable for breeding to proceed at the maximum rate, the dry season should in a general way be more favourable to the fly, assuming its dependence on the larger mammals for its food supply, than the wet.

It does not follow, however, that this is necessarily the case in particular instances. Certain tracts of country dry up so thoroughly towards the end of the dry season that they are deserted altogether by most species of game. As has been remarked by several observers, however, wart-hog and duyker are usually to be found even after the grass has been burnt off over a wide area. These species, especially wart-hog, may serve to keep the flies from starving, but conditions cannot be said to be favourable to increase. Fly under such conditions is almost invariably very hungry, the proportion of the sexes caught tends to approach equality and pupae are

extremely scarce.* Fly appears to be extremely numerous and is certainly extremely pertinacious. Half-a-dozen flies that are eager for blood give a far greater impression of numbers than half-a-dozen "following" males. Fifty or sixty really hungry flies would give the impression of hundreds. Several investigators have indeed drawn attention to the fact that the numbers of tsetse under such conditions may be more apparent than real. The writer can only speak with experience of one locality of this nature (Gorai River, Lomagundi), but a noteworthy point was the extreme localisation of the fly, few being met with except at the point where the path crossed the water-course, and here they seemed to swarm. When the writer camped at this spot for several days, the flies became very much less troublesome. Many presumably fed on the two dogs accompanying the party, and a few on the natives. Some 80 odd were caught, and the party was then left in comparative peace. Nowhere else in the dried-up triangle of country formed by the Hunyani and Ambi Rivers with the escarpment were flies met with in any numbers.

The following April no fly was encountered at the river crossing, but they were present in the neighbouring mopani forest in very moderate numbers, giving the impression of a decrease since the previous November. In regions such as this it is judged that the wet season must constitute the main breeding period, owing to the return of game with the rains, but that under these conditions the fly does not attain the same numbers as in areas where more favourable winter haunts are found. The visitor in the dry season meets, however, a large proportion of the fly population at once, whereas if game is plentiful he probably meets only a fraction.

This argument may not apply universally to localities where fly seems numerous and game very scarce. In the area referred to it was actually shown that game was moderately plentiful when the country was not dried up. Data for times of year other than the dry season appear to be lacking in respect to most of the classic instances where fly apparently abounded in the absence or extreme scarcity of game.

During the earlier part of the dry season, in May, June and July, the coldest weather occurs, and there is little doubt that the fly breeds less freely at this time of year and that the pupal period is more prolonged, both of which facts tend to check increase. On the whole, the fly tends to be less numerous at this time of year, particularly in July, but during August and onwards to the advent of the rains considerable increase occurs. With the advent of heavy and persistent rains the fly scatters and therefore appears to decrease suddenly, although this is probably only apparent.

The answer to the question as to whether the dry season is in general a period of stress for the fly or not, except in so far as the breeding is influenced by temperature, would appear therefore to be in the negative as far as conditions similar to those of this territory are concerned, and the writer is of opinion that, excepting certain localities, far from being a time of stress, the latter part of the dry season is probably the most favourable and important period of the year under normal conditions. Furthermore, it would appear that the later the rains are in commencing, the greater the insects' capacity for increase. That such conditions are not inimical to the fly

*The writer is largely repeating results obtained by others in Central and East Africa, although observations in S. Rhodesia are entirely in accord.

is shown by the fact that the latest onset of the rains recorded in recent years in the territory, namely in 1912, when no appreciable rain fell till towards the middle of December, was followed next year by the largest extension of fly recorded in connection with the Sebungwe fly area.

The Effect of Grass Fires.

Another point is the stress laid by certain investigators on the efficacy of grass fires in reducing the fly. The present writer has been unable to obtain the slightest evidence that grass fires in this territory have any material effect on the number of fly, indeed the evidence to the contrary is almost conclusive. One of the most striking instances was recorded on the Gaori River below the escarpment in the Lomagundi district. Fly in November 1910 was still confined to a dry season haunt, which consisted in this case of shady trees on the bank of the dry water-course mentioned above. For some reason the grass had not been burnt until three days (according to the natives) before the writer's visit, and the presence of still smouldering trees and the general appearance of the ashes of the grass showed it to have been burnt extremely recently. The fire had swept through the country over a very wide area. Fly was present in considerable numbers, as already mentioned, attacking the party very persistently. When a second visit was made to the spot in April of the next year, it was found that the grass throughout the " focus " stood as high as a man's chin and was so thick that it was far too laborious to attempt to make headway through it. The fire the previous November must therefore have thrown up flames twelve to fifteen feet into the air. These fires are an annual occurrence, here as elsewhere, and yet this little water-course is well known to all using the path which crosses it, as a fly centre, where the pest is always very much in evidence in the dry season. This was, as a matter of fact, the reason why that particular foot-path was followed. Many other less striking instances have come to the writer's notice during the past ten years, and the accumulated evidence has induced an entire loss of faith in the efficacy of grass fires in reducing the fly. As a matter of fact if tsetse-flies could not avoid grass fires they would surely long ago have been exterminated in parts of the country inhabited by natives. Of course even in Southern Rhodesia much patchy burning of the grass occurs, but the long, intensely dry winter presumably favours burning over wide areas more than conditions in Uganda, for instance. It is difficult to see how the flies could avoid a roaring furnace like that along the Gorai River by mounting in the air unless they went to a very great height (for a fly), but the contiguous mopani would afford a refuge, as in this type of forest the grass is always very short, and is sometimes almost altogether wanting. If large areas of country infested with fly were covered with long thick grass better results might be anticipated. Possibly this is the reason that greater effect on the fly has been noticed elsewhere.

The Value of Mopani Country to the Fly.

Both Duke and Fiske, referring to Uganda, speak of the fly showing hunger in the long grass season, which is of course the latter part of the wet season and earlier part of the dry. This is attributed to difficulty in locating game. The point is extremely interesting, because from Duke's description of the Masindi area comparatively long

grass apparently occurs over wide areas. Conditions differ in various parts of the fly-infested areas of Southern Rhodesia, but in the great majority mopani belts are a feature of the country, and the fly certainly shows a strong preference for this type of forest in the wet season, deserting its dry season haunts where the grass is usually long and thick, sometimes very long. The sweet short grass of the mopani is very attractive to many species of game in the wet season, though the reverse in the dry, and the fly certainly has the best chance of meeting and perceiving game in this type of country during the rains. The mopani grass, however, dries up very quickly after the cessation of rains, being shallow-rooted and of little substance, so that it loses its special attractiveness very shortly after the close of the wet season. Nevertheless, this type of forest is much haunted by impala and wart-hog even at that time, and many other species are commonly seen in it, if game is at all plentiful in the neighbourhood. Whilst, therefore, it is probable that in Southern Rhodesia the long-grass season is not in general a time of stress for the fly, the fact is in no way opposed to Fiske's observations. In this connection it may be mentioned that the only sex count made by the writer in the long-grass season was in April 1911, with fly taken in mopani, and resulted in 53 males to 3 females, by far the most extreme disparity yet recorded in the territory. The fly's habit of avoiding thick undergrowth would indeed suggest a difficulty in finding its hosts in such an environment. It is quite possible that in certain parts of the fly areas in Rhodesia a time of stress for the fly may occur in the long-grass season, as the mopani is not ubiquitous, being absent, so far as the writer is aware, from most of the Jetjenini fly area and from certain parts of the Sebungwe area. Prospectors and hunters in this territory have constantly associated mopani and tsetse, and although obviously not essential to the tsetse, it is quite possibly of value to the fly under certain conditions. According to Fiske's observations it ought theoretically to be of value in the long-grass season, and possibly it affords a refuge from grass fires.

The Question of Migration.

The next point is the question of the migration of fly, corresponding to the movements of game, or under stress of hunger. Now it is far from the writer's intention to adopt a dogmatic attitude on this subject, but it would seem difficult to reconcile any habit of this nature with a number of known facts. First, in regard to the question of fly migrating with game, we have the phenomenon of restricted fly-areas and their mode of extension. It has already been pointed out (Bull. Ent. Res. x, p. 88) that the limits of a fly area are not necessarily permanent. The permanent limits are marked by the impingement of favourable on unfavourable country; that is to say, the country beyond the limit is for some reason or other unsuited to the tsetse. Transitory limits are, however, formed by the high-water-mark, so to speak, of the advancing flood when the fly is spreading, as has been the case in this territory since the rinderpest. Transitory limits would also be apparent if the pest were receding.

The advance of the pest is, however, comparatively slow, and in no way comparable with the powers of movement of the fly itself or of game. Much potential fly area, known to have been infested in pre-rinderpest days, is still free from the pest, although the latter is gradually occupying more and more of its old country.

Is it possible for these conditions to obtain if the fly had a habit of migrating with herds of game, apart, of course, from the males' habit of temporarily accompanying moving animals and human beings? Herds of certain species of game are more or less constantly on the move in and out of the fly area, and if the fly accompanied them in their wanderings the whole of the potential fly area would certainly be very quickly occupied.

It may be contended, however, that the fly only follows "trekking" game under stress of hunger. This appears to imply a rather marvellous instinct on the part of the fly. Any fly suffering from hunger that encounters a herd of game is likely to be a full-fed fly in a space of time measured by minutes, and is then not in a condition to follow anything for some time. Must we, therefore, suppose that the fly restrains its appetite in order to accompany the herd into another part of the country? Again, game travels as a rule by night, and though there are numerous records of fly "biting" on warm nights, it is essentially of diurnal habit. Finally, we have apparently no records to show that the female flies follow animals or human beings for any appreciable distance at all, whether they are hungry or not. The writer's observations are all to the contrary, and published accounts apparently give no record of other than males exhibiting an obvious following habit. Much argument has in fact been based upon the supposition that the female flies only seek animals and human beings for the purpose of feeding, whilst the males follow for other reasons.

These considerations have led the writer to be extremely sceptical concerning the fly's alleged habit of migrating with game. Regular movements of game in a given direction might, it is admitted, help the spread of the fly in that direction. The allusion is to the daily movement of game from its feeding grounds to water, as, for instance, game which feeds in the neighbourhood of a dry river and moves across to a flowing one to drink (e.g., the Mzola and Kana Rivers in this territory). In the same way, regular traffic along a road would tend to spread the fly, if conditions admit of spread, but this is quite apart from the question of fly migrating with migrating game.

The second aspect of the question is that of fly migrating without help from moving game, when pressed by hunger. This would be a serious state of affairs; as they might be attracted by the settler's herds of cattle, take up their residence in the vicinity of his "kraal" and deposit their larvae under his orange trees. Such a development might well have happened in the writer's experience if hungry fly had a habit of migrating even three or four miles to a food supply. The important point is that it did not happen. The idea of this form of migration has, as a matter of fact, always puzzled the writer. How is it supposed to take place? Do the tsetse send out scouts like bees to locate a better piece of country and then rise in a swarm to follow these guides to the new locality? Does some instinct inform them that better conditions prevail elsewhere, so that they rise with a common impulse and migrate thither? Do they, under stress of hunger, migrate *en masse* at random guided by chance, or perhaps the direction of the wind? Do they migrate by a series of short journeys, gradually tending day after day in one direction? Unless the movement takes place at random, this presupposes a knowledge of where

better feeding grounds are to be found. Or, finally, do they migrate individually? In the latter case they might take many directions and a corresponding increase in another part would not be likely to accompany the decrease in the original centre. Fortunately for the neighbouring settlers, where we have had a clear case of hunger conditions as regards game, in the Hartley district, the diminishing fly became gradually restricted in range as the game decreased, and still adhered to their old haunts, whilst numerous cattle worked with more or less impunity amongst the Shagari mines a few miles away on the one side, and settlement proceeded along the railway line with rapidly decreasing losses on the other. The destruction of the usual haunts by the felling of the forest did, however, appear to cause a scattering of the tsetse, which died out, probably in consequence. The fly along the Gorai River, mentioned above, were obviously very hungry at the time of the writer's visit in November 1910 (out of some 82 flies caught actually more were females than males), and from all accounts this is an annual occurrence at this spot; but although game was more abundant on the Hunyani a few miles away, the flies apparently preferred to endure hunger in this area rather than migrate. They were not, it must be confessed, absolutely starving, as wart-hog and duiker were actually seen in the fly haunts; but their meals were without doubt sufficiently irregular to keep the appetite of the majority very keen. Fly, on the other hand, was comparatively scarce on the Hunyani where more game was to be found.

The writer has, in fact, been able to find no evidence during the past ten years in this territory that the fly has any tendency to migrate, apart from the seasonal scattering during the wet season, as a result of which the pest is much more uniformly distributed over the infested area than during the dry season. Although new areas have been invaded by its gradual spread, no incursion of fly into localities other than those immediately adjacent to the former infested areas have occurred. It is readily admitted that an *apparent* migration might take place in the course of time, the fly increasing in a newly invaded area and decreasing in the old, but this does not imply migration. In any case in Southern Rhodesia the invasion of new areas, in the writer's experience, has not been accompanied by any corresponding reduction elsewhere, nor has reduction in an old area been accompanied by any noticeable increase elsewhere. The fly appears to increase or decrease in any area solely in relation to its ability to breed successfully.

On the whole there seems little reason at present to believe in any form of migration in respect to *Glossina morsitans*, other than the seasonal scattering with the advent of the wet season, and forced movements induced by destruction of the forest. In the latter case the fly naturally follows the receding shade.

The Question of Fly moving about Infested Areas with Game.

The idea that fly locates game and follows its movements more or less continuously, at least within the limits of infested country, is not absent from the writings of serious investigators. In this connection it is essential to distinguish between following for a limited distance, as is the well-known habit of the males, and possibly of the females to a much less degree, and the alleged habit of the fly attaching itself to the herds and accompanying them in their wanderings day after day. The writer has been able to find no direct evidence adduced in support of this idea,

and there are certainly many reasons why such a habit is, to say the least of it, unlikely. The question is intimately connected with that of fly migrating with game; for if the fly followed herds of game within the infested area, there appears to be no obstacle to its following the herds beyond it, provided that the country entered is potential fly country. This, as an attempt has been made to show, is at least not its general habit. The further difficulties in the way of accepting this idea, mostly already mentioned, may be briefly summed up as follows:— (1) female flies are apparently not known to follow to any great distance at any time; (2) gravid females seek seclusion, and are not in the least likely to attempt to follow a moving herd; (3) hungry flies tend to feed fully, and full-fed flies abandon their hosts, which are unlikely to remain in the vicinity until the flies recover; (4) the fly is diurnal in habit, whilst game moves largely at night. It would seem therefore that the only individuals capable of following game even for a few hours are those which do not desire to feed. The majority of observations indicate that only the males exhibit a tendency to follow, although the possibility of non-gravid females doing so is not altogether excluded. In any case it is well known that even the males do not follow human beings for more than an hour or so, but gradually fall away, and there seems little reason to think that they would exhibit a different habit in respect to game. Even supposing they followed till nightfall, they must surely lose touch with the herd after dark.

It appears probable that the tsetse-fly neither ranges the forest in search of its prey, nor follows it when encountered for any great length of time, but that it waits for the animal to come within the range of its perceptive powers. The fact that fly is constantly met with at the same spots* strongly suggests ambush rather than pursuit, and the writer has certainly no experience of having encountered fly in circumstances that suggested anything else.

The Maximum Distance at which the Fly can detect its Hosts.

Direct experiments are needed and planned to determine this point as far as possible. It appears necessary to distinguish between the maximum distance at which the fly readily perceives its prey, so that a man or animal would not pass by without being observed, and the distance at which it might locate say a herd of game grazing for several hours in one spot.

Some of the early explorers and hunters who encountered tsetse-fly were most emphatic that a very short distance might separate complete safety from certain death for their cattle, a narrow stream being sometimes mentioned as the dividing interval. Like other statements emanating from untrained observers this assertion, though undoubtedly greatly exaggerated, appears to have some foundation in fact. It would be possible to mention numerous personal observations of having been very

*The writer is aware that observations have been published of fly having been encountered in quantity at certain spots on one occasion and only in very small numbers at the next visit. During the wet season this is quite likely, as the fly is not confined by lack of shade, and when carried even for a short distance is hardly likely to return to exactly the same spot. Even in the dry season the passage of a herd of game might make a very material difference for a few hours, the hungry flies feeding and seeking seclusion, and the non-hungry males following the herd. Nevertheless, allowing for the difference in distribution in the wet and dry seasons, the statement is substantially correct.

little molested by fly on one side of a vlei, whereas on crossing to the other, some two hundred yards or so away, the party was immediately assailed by great numbers. A rather striking instance of the fly's limitations in this respect occurred in October 1919. The writer passed along a foot-path about 9 a.m. to examine a salt vlei near the Shangani for fly. None was seen till this vlei was reached and an hour was spent walking all round the margin, during which time only four tsetse were caught. Returning, the route taken aimed to cut the path at an acute angle, and when within 100 yards of the path on reaching a shady tree a number of tsetse suddenly attacked the party and " bit " with extreme voracity. Yet about an hour earlier the writer with his natives had passed within a hundred yards without being perceived. It cannot be proved definitely that the fly were there an hour earlier, but there was no spoor to indicate that any game had passed in the interim, and as the morning was hot the fly would hardly have crossed the leafless mopani to this particular tree. The writer was extremely impressed by this particular instance, and as a matter of fact the limitations in the fly's capacity for readily detecting a food supply has been a constant source of surprise throughout investigations now extending over ten years. A movement of fifty yards or so in a fly haunt frequently brings an accession in numbers of hungry insects and in numerous cases when all the flies seen were being collected, this phenomenon has been particularly marked. If it be accepted as an axiom that an animal or human being attracts all the hungry tsetse within a radius not exceeding the fly's powers of perception, then the limitations of the fly in this respect have been proved again and again ; for fresh hungry flies have undoubtedly been constantly encountered after a very short movement, whilst some two hundred yards or so has been found sufficient to keep a party comparatively free from attack whilst the fly swarmed that distance away. To mention another instance, in September 1913, the writer halted for breakfast on the south-east side of Sipane Vlei, between the Sengwa and Sassame Rivers in the Sebungwe district. A certain number of tsetse had been picked up *en route*, and the boys fetching water brought in more, so that a few bites were received. Some time after breakfast the writer took three natives to the north-west side of the vlei, some 300 yards away, and found the fly in numbers, some 87 being caught with one net in an hour. The wind was from the south-east and had been blowing over the party towards the fly haunts for at least two hours ; yet the bulk of the flies had not been attracted over this comparatively short distance, though they attacked the party in considerable numbers when their haunts were entered. Further visits to this spot have been made since, and it has been found that by camping on the south-east side of the vlei the attentions of fly could always in a great measure be avoided.

From the foregoing considerations it is believed that the tsetse-fly is only capable of readily detecting its hosts at a comparatively short distance, probably less than a hundred yards. It might, however, be longer in the wet season, when scent presumably carries further than in the dry.

If this limitation be proved, the fact increases the difficulty of accounting for the presence of fly in numbers in areas where large mammals are markedly scarce. It apparently remains to be proved, however, that fly occurs in numbers in any tract of country where large mammals are markedly scarce at all seasons of the year. If such a phenomenon does exist, the writer admits frankly that it appears irreconcilable with the theory of the vital association of the two forms of life.

Is it not possible that this limitation might account to some extent for the gregarious habit of the tsetse, the flies benefiting by the combined perceptive powers of a number instead of relying on those of single individuals ? The value of numbers in regard to perception will hardly need urging upon anyone who has hunted antelope or other gregarious game.

The Following Distance of Female Flies.

It appears very important that attempts should be made to determine as accurately as possible the maximum distance to which female flies may be carried by game, man, etc. The point has a great bearing upon the question as to what would constitute an effective barrier to the fly's advance, and also upon the question of the fly as a whole migrating with game or moving about the fly area in company with its hosts. The writer has as yet been able to prove following on the part of the females up to only about 400 yards, although one instance has occurred where a specimen had *apparently* followed very much further than this, over a mile in fact. The observation in the latter case was, however, liable to considerable error. Some experiments in this connection were planned for the writer's visit to Sipane Vlei in August 1919, but could not be carried out owing to the unexpected scarcity of fly in that centre.

Sipane Vlei and some other Localities in 1919.

In a recent paper * the writer pointed out that the somewhat delicately balanced state of affairs which exists at the most favourable dry season haunts of the tsetse, namely the margin of vleis containing green grass in the dry season, is apparently liable to be somewhat easily disturbed by any agency tending to prevent game from visiting the vlei with its normal regularity. This disturbance, it was pointed out, would enhance the effect of game reduction by hunters, and might also have operated in the rinderpest epizootic, which undoubtedly induced abnormal movements of the panic-stricken remnants. These views have received some indirect support during the dry season of 1919, when for the first time since the rinderpest a reduction of fly in areas of the territory unaffected by civilisation has been recorded. This reduction is local, and extension since the previous year was recorded in one other part of the country, and may have occurred elsewhere. A reduction has been reported in the northern part of the Umniati fly area by Dr. Alec Mackenzie of Gatooma. Dr. Mackenzie's statement is to the effect that he found no fly at all in December 1919 in many parts where they are usually numerous near the Sakugwe and Umniati Rivers on the road from Gatooma to the Emerald Mine, and only a few finally at the headwaters of the Mvumvudzi and Urungwe Rivers, visited for the express purpose of locating the fly. There is, however, one spot where reduction can be proved on something like a mathematical basis, namely Sipane Vlei, lying between the Sengwa and Sassame Rivers in the Sebungwe district.

The rapidly-expanding Sebungwe fly area reached the Sengwa River from the west by 1910, and fly was first recorded at Sipane in 1913, though it may have been present at least a year earlier. In late September of that year it was present in great numbers, and 87 were caught with a net in one hour, in order to establish some sort of basis for

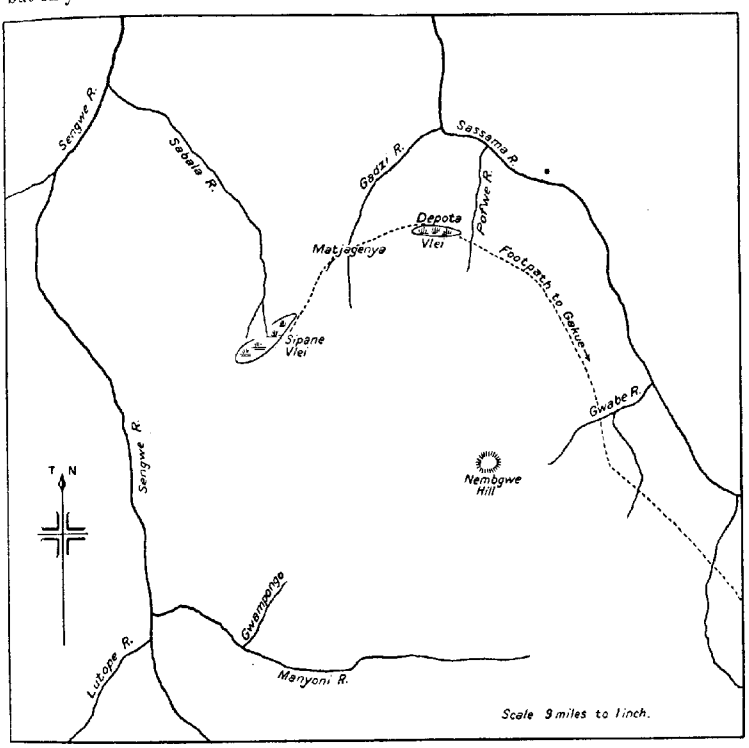
*Bull. Ent. Res. x, p. 83.

later observations. In November 1914, the flies in the vlei were "like a swarm of bees" around the individual who penetrated their haunts, and the ease with which pupae were collected during that visit has already been recorded. In August 1916, fly was extremely abundant, and living pupae could be found (some 30 were collected in a few hours), though the latter were not as abundant as in November 1914.* In late August 1919, the writer spent ten days at the vlei, for the purpose of chopping down the evergreen trees as an experiment. Hardly half-a-dozen fly were seen in the course of the day, where formerly they swarmed, and search for living pupae was entirely unsuccessful, notwithstanding that much more time was available than on previous visits. Only a few empty cases were found in the usual breeding places, and from these the flies had apparently emerged normally, there being no indications of parasitism.

In seeking a probable explanation of the decrease it was impossible to ignore the marked influence that the heavy rainfall of the two previous wet seasons had had on the country. The wet season of 1917–18 was the heaviest recorded since 1890–1, and was of a peculiar nature, the skies remaining overcast for weeks together, so that the maize crop suffered severely from excessive wet and lack of sunshine; conditions were thus ideal for maximum penetration. The following season's rainfall was also above the average. The first difference noted in the appearance of the country was the fact that the gusu (*Brachystegia*) forest bordering one side of the vlei had not yet lost its foliage, although quite leafless in August 1916 (see photograph, Bull. Ent. Res. x, p. 90, pl. ii, fig. 2). The same remark applied in a lesser degree to the thorn thicket (isi-nanga). The mopani, on the other hand, was practically leafless, except half-a-dozen trees in a wet situation on the edge of the vlei itself. These were in full leaf, having apparently grown out again since the fall. The gusu, it may be remarked, showed no young foliage and the leaves were falling sufficiently rapidly to show an appreciable diminution of shade during the ten days of the writer's stay. Careful inspection of the environment revealed a considerable extent of green grass to the south-west and west of the vlei, which was not in evidence during previous visits. Further, game was remarkably scarce in comparison with previous experience, and such as occurred was not feeding at the vlei itself, but on the green grass mentioned away from the vlei. With the exception of two small herds of impala, one kudu cow, one wart-hog, a rhinoceros, a wild dog and several duiker, no game was actually seen, in spite of daily excursions in all directions. Fresh spoor of a herd of zebra and another of sable was found in the vicinity. A lion drank one night at the vlei, as also did a solitary buffalo bull. This sounds a rather formidable list, but it represents the results of ten days exploration of the country within a radius of about eight miles of the vlei. A pack of wild dogs was apparently hunting the neighbourhood, and this may account to some extent for the scarcity of antelope, but the main point ascertained was that the few antelope present in the vicinity were not visiting the vlei for the purpose of feeding as is usually the case. They apparently found more attractive fare in the stretches of green grass away from the vlei (see sketch-map).

*In connection with the comparative smallness of the numbers quoted here and elsewhere it should be noted that no trained natives were available and that the pupae and flies were practically all collected by the writer personally.

Further evidence in support of the theory lies in the fact that fly was actually found more readily, though not at all abundantly, in the green grass areas away from the vlei, where such game as occurred was grazing, than at the vlei itself. The general prevalence of shade apparently rendered this possible under the prevailing conditions, although this is not usually the case at this time of year. A few fly were even met with in the gusu itself, which was unattractive to the majority of game, but only three were seen in a walk of several hours.



The obvious question is whether the fly had decreased from failure of the birth rate to equal or exceed the death rate, or from the majority having migrated. There was certainly no corresponding increase of fly within a radius of seven or eight miles of the vlei, as the country within this radius was thoroughly explored at the time. Nor had they shifted to the nearest known dry season haunt, which is Matjagenya on the Gadzi River, some seven miles away. There is no evidence of the appearance of fly at any point in this region outside the limits of the known area, and if the fly had migrated *en masse* in this direction it must have been noticed, as the country is inhabited. As a matter of fact the natives questioned stated that they knew of no fly outside the previously marked limit in this locality. It would appear, therefore that if the fly had migrated it must have moved back into the infested country

and for a distance exceeding the radius explored around Sipane Vlei. It is obviously possible that this may have occurred, but it appears very unlikely. Whatever be the correct explanation, it is certain that Sipane Vlei had ceased for the time being to serve the purpose it had served in the past, as a favourable breeding haunt for the fly during the latter part of the dry season. During the season of dispersion a considerable area of country would be affected by this fact.

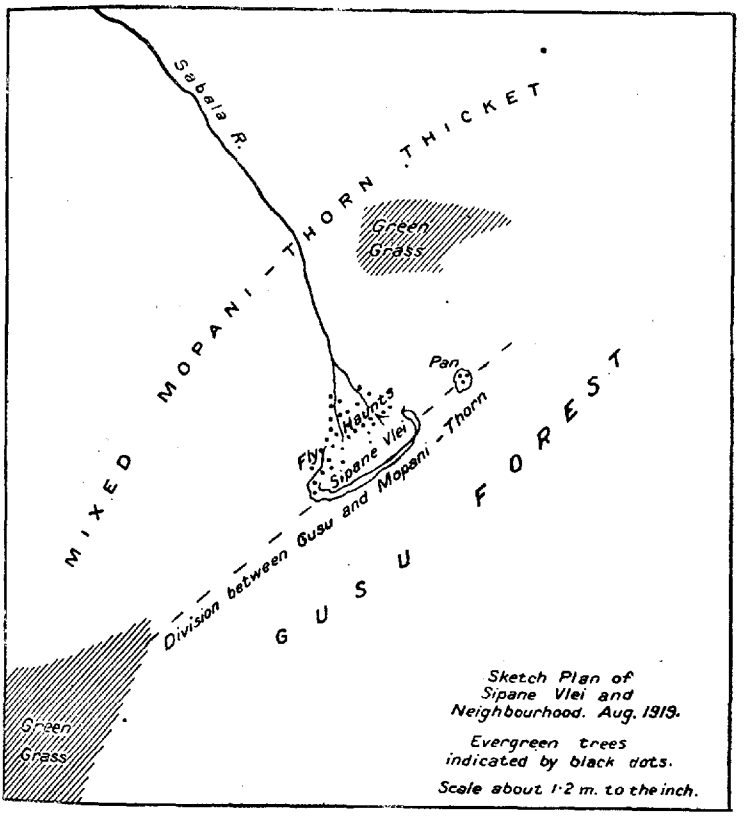
It is interesting to note that some years ago an experiment was planned in connection with Sipane Vlei with a view to determining whether the fly there was dependent upon the visits of big game or otherwise. The plan was to surround the whole vlei with a game-proof fence and thus keep the game away during the season of concentration. It was not carried into effect on account of the doubtful practicability of effective control at such a distance from communications. It would almost seem, however, as if meteorological conditions, in reducing the peculiar attraction of the vlei to game, had effected a demonstration instead. Unfortunately further observations bearing on this point will not be possible at this centre as the evergreen trees on the margin of the vlei have now been cut down.

Time was not available for a detailed inspection of other dry season haunts in the same region, but fly was scarce at the crossing of the Gadzi River, known to the natives as Matjagenya, on the way to Sipane, though formerly numerous. The natives resident at this point also bore out this observation. Again, at Depota Vlei some seven miles east of Matjagenya, no fly at all were seen, and some natives who had taken up their residence there the previous year had a number of apparently healthy dogs. They stated that they never saw fly near the vlei, although a very few were seen there by the writer in 1916. Winter shade is scarce at Depota, otherwise it would be a typical first-grade focus, as it is attractive to game as a rule. The writer has in the past seen eland, kudu, sable, impala, zebra, and sessaby in the vlei, and the fresh tracks of buffalo and rhinoceros in addition. In August 1919 only one duiker was seen in the neighbouring forest, and the tracks of three kudu. For the moment, therefore, the fly seems to be retrogressive rather than otherwise in this region, and it is essentially a region of isolated dry season haunts.

On the other hand, at the point where advance has been recorded definitely, namely up the Shangani River, the region is one of diffused dry season haunts (second and third grade foci), and game was very plentiful in October 1919, though their numbers had doubtless been augmented owing to the organised shooting further down the river which commenced in June. Here then we have an illustration of " the fly following the game," only as the area of increase is some ninety miles, as the crow flies, from Sipane Vlei the fly can hardly have migrated thither. The presumption is that conditions the previous year favoured breeding in the one area, and were unfavourable in the other.

Whilst conditions in the northern part of the Umniati fly area have no doubt been affected to some extent by the efforts of hunters in shooting game for the " Emerald " and " Copper Queen " Mines, and the portion to the east of the river considerably affected on account of being in the open shooting area, the writer has been, so far as is known, the only European visitor to Sipane Vlei for several years past.

It is not claimed that the only way in which one or two abnormally heavy wet seasons could affect the tsetse-fly lies in inducing a wider distribution of water and attractive grazing during the dry season. The involved interrelationship between the tsetse fly, its diseases and enemies, the enemies of its enemies, and so on, is almost a closed book at present, and this interrelationship is no doubt affected in some degree by the season. It is only intended to point out a possible explanation of the observed phenomenon as a basis for future research. The abnormally heavy rains of the past wet season have certainly affected the appearance of some parts of the country in the dry season to a marked degree, and the fly has undoubtedly decreased in certain areas, one of which at least, as the writer has endeavoured to show, has also been affected by the increased rainfall.



Curiosity naturally suggested reference to the records of rainfall in the territory with a view to ascertaining whether any record of one or two seasons of exceptional severity preceded any definite information concerning reduction of fly. The available rainfall statistics unfortunately date no further back than 1888 and in the

intervening period there is only one record of two consecutive wet seasons comparable with those of 1917–18 and 1918–19. These are the seasons 1889–90 and 1890–1. The total fall in these two seasons at Bulawayo considerably surpassed that of the recent two seasons, the number of inches recorded being 87·81 in the earlier couplet against 76·13 for the later. Was this heavy fall followed shortly by any marked reduction of tsetse? There is some suggestion to the effect that it was, at least in certain parts of the territory, although it is of such an indirect and unsatisfactory nature that it is practically valueless.

It is curious, however, that during this very time, a marked recovery from a period of decrease seems to have taken place in the region of the Zambesi. In a foot-note to a paper by the writer (Bull. Ent. Res. v, p. 100), Captain Selous' opinion is recorded that by 1888 "the belt shown to the west of the Victoria Falls had disappeared," and "that much of the fly to the east of the Falls had also gone by that date." This statement was doubtless substantially true in 1888, in fact there is other evidence that fly was decreasing in this area during the preceding years (v. Dr. Holub, Austen's Monograph, p. 203). Nevertheless Selous' statement is misleading and should be corrected in case other investigators may use it as a basis for argument. The writer has first-hand information to the effect that fly was numerous between the Falls and the Zambesi-Chobe confluence in 1893, and it is apparent that an increase of fly took place subsequent to 1888. The first-hand evidence referred to is contained in a report by Mr. A. Giese, Cattle Inspector, to the Chief Veterinary Surgeon, Salisbury, dated 9th July 1918. The report is worth quoting in full, although some of the matter does not bear on the present argument. It appears that the fly did actually disappear from this part of the country at the time of the rinderpest, whatever may have been the position of affairs near the Limpopo.

Mr. Giese's report is as follows :—

"9.vii.1918. The following notes are reminiscently penned because they may serve as a guide as to where to expect the tsetse-fly, now re-appearing west of the Gwaai,* to spread to should this re-appearance be only a return to localities driven out from or killed by the rinderpest, and not as well to localities which the fly had already voluntarily disappeared from before the rinderpest arrived.

"In 1861–2 Baldwin(?) brought the first waggons to Deka commencing the track which eventually grew into what is now known as the Pandamatenga or western border road. He had to leave his wagons at Deka and proceed to the Zambesi on foot as the intervening country was infected by fly.

"Somewhere about the middle seventies Geo. Westbeach established his later far-known trading station at Pandamatenga, when the fly had receded further north somewhere north of Gazume Vlei. At the same time, or a little later, transport could be taken to the Victoria Falls and to Bingua Spruit—about railway cottage 277—from where Westbeach's waggons used to fetch grain traded in the fly-infested country to the east; also that broken stony country north of the present Matetsi siding was believed to be free from fly right up to Victoria Falls.

* No fly has as yet been found west of the Gwaai, but outbreaks of trypanosomiasis have occurred during the past three wet seasons.

"In July 1893, the writer's first appearance in these parts, ox transport was left at Gazuma, but fly was found between Leshuma and Kazungula, Chobe and Zambesi junction, and from Kazungula right up the Chobe and right down to within a few miles of the Victoria Falls, fly being particularly aggressive on the latter stretch.

"In 1894–5 during various trips to what is now the Wankie Colliery all animals had to be left at Deka; in fact when the writer pegged the present Deka farm in 1895 animals were not allowed near its S. E. beacon.

"During these latter years the southern boundary of the fly area ran roughly from Galobe—Gwaai junction more or less west but north of that open park-like country round and to the south of Chumagu Malishi and Makolo to places near the present Kennedy's Halt, and hunters used to take their ox waggons thus far north.

"At the end of 1897 the writer took a horse up the Chobe and in 1898 six spans of donkeys to the present Wankie Coal Mine, all fly having disappeared then."

In answer to direct queries by the Chief Veterinary Surgeon Mr. Giese replied as follows under date 30.vii.1918:—

1. "*What species died of rinderpest?*

"Eland, buffalo and kudu principally, and in the order mentioned as regards numbers found dead and the occurrence of the species at the time. The greater mortality among the eland was not due to their being more susceptible to disease but to their occurring in much greater numbers than the other game. This they still do. Of other game reedbuck probably suffered most.

2. "*What was the rate of mortality; were there any survivors?*

"In 1898 the only surviving buffalo, between Kazungula and the Gwaai were one bull, 3 cows and 3 calves, running 7 miles west of the present Colliery, and a somewhat similar number on the lower Inyantue; which means that these were the only buffalo left in Matabeleland west of the Gwaai, because their habitat did coincide with the tsetse-fly.

"What the number of buffalo was in pre-rinderpest days one cannot say, as they were scattered owing to the natives carrying guns; but the increase of these 7 animals (survivors) is a fairly compact herd of some seventy animals now confining themselves to a belt of country 20 miles by 30 miles to the west of the railway. The Inyantue herd is a little larger.

"There were stray survivors of kudu and they also have more than recovered owing to the absence of firearms; there are more kudu than any other antelope, Sharpe's steinbuck excepted, in the broken and hilly part of the Wankie District.

3. "*Did the fly disappear at once?*

"The writer left Deka on 15th January, 1896, when fly were as stated in his notes, arrived in Bulawayo mid-February and was sent for from the C. C's office to give an account of what he knew of rinderpest which was then approaching. When he returned after the Rebellion in 1897 the fly had disappeared."

The record is extremely interesting in showing that fluctuations in the distribution of fly on a moderately extensive scale have occurred in the past apart apparently from overwhelming game destruction, although the hunters appear to have been of opinion that the decrease of fly during the period preceding 1888 was due to their

inroads into the number of buffalo. As a matter of fact, events in this region seem to have contributed largely to the solidifying of Selous' opinion that the fly was dependent upon buffalo.

The rainfall in the Zambesi valley frequently differs very considerably from that in the remainder of the territory, and it is unfortunate that no records in this area for the period concerned appear to be available.

The records, are however, instructive in regard to the influence of a series of seasons of low rainfall. At Kariyangwe in the Sebungwe district the rainfall recorded for the three seasons 1909–10, 1910–11 and 1911–12 was extremely low. This station was then closed down, but referring to the Wankie records, somewhat further from the scene, we find that the next two years were also very low indeed. During this period the extension of the Sebungwe fly area proceeded at its maximum speed, as may be seen by a glance at the author's map (Bull. Ent. Res. x, map 1). The records of advance in this area are moderately accurate as regards the three year intervals marked on the map, with the exception of the north, where the discovery of tsetse-fly on the lower Sengwe River in 1913 indicated that the previous limits in this area, visited only at long intervals by officials who traversed the country rapidly, were probably faulty. It is not possible, however, to obtain accurate yearly records. The dry season of 1913 was remarkable for advance in almost every direction, excluding a portion of the western limit where the fly appears to have reached the division between favourable and unfavourable country. The rains were very late in 1912, no serious showers falling until near the middle of December. Dry season conditions were thus unusually prolonged, and it is believed that such conditions favour increase of fly.

To recapitulate, whilst the writer is far from attaching any exaggerated importance to these limited records, they are certainly suggestive of abnormally heavy wet seasons having a deleterious effect on the fly in certain areas, and of a series of seasons of low rainfall, especially if late, favouring increase. Intense and prolonged dry season conditions, such as occur during a cycle of years of low rainfall, are judged to favour the fly at centres which resist the action of drought best, owing to the consequent concentration of game. A rise in the water-table after an exceptionally heavy season or two causes a disturbance in the usual conditions by inducing a more general distribution of good grazing and water throughout the country, and a proportionately reduced attraction of the "focus" to game.

It is much to be regretted that the writer's itinerary in 1918 did not include Sipane Vlei. The tremendous rains of the 1917–18 season had a very marked effect on the forest lying between the railway line and the Gwaai River on the western side of the territory, and it is reasonable to suppose that conditions at Sipane Vlei may have been similar to those in 1919, seeing that at Gokwe, the nearest meteorological station, 43·03 inches fell in the 1917–18 season and 33·10 inches the 1918–19 season, although even the latter is well above the normal for that district. If the writer's theory is correct, fly should have been numerous and hungry in the dry season of 1918, pupae being, however, scarce, resulting in a great diminution of fly by 1919.

This theory is very much in accordance with observations published by Lloyd (Bull. Ent. Res. vii, pp. 67–79) with reference to Northern Rhodesia. Lloyd draws

a most necessary distinction between apparent and real abundance of fly, and shows how the percentage of females caught in the ordinary way varies in inverse ratio, and the number of pupae secured in direct ratio, with the abundance of game. Here we have direct observations indicating that scarcity of game induces hunger and hunger inhibits breeding. Both these observations have received support from other investigators, including the comparatively scanty observations in this territory, and appear to be in a fair way to become established. If this proves to be the case the effect of hunting in the early days in the Transvaal and the apparent effect of the rinderpest would appear to be quite comprehensible, in spite of the fact that the game was not completely eliminated in either case.

The result of a heavy reduction of game would seem to follow logically, quite apart from complete elimination, namely irregular meals at long intervals—perhaps some individual starvation—in any case a greatly reduced birth rate. If the birth rate were checked at all suddenly, especially during the season of concentration when the larvae are deposited within a limited area, the fly's parasites might be expected to destroy a much higher percentage than before. The writer is very much in agreement with Duke's contention as to the probable effect of a sudden or "cataclysmic" change in the distribution and numbers of game animals. The local distribution of *G. morsitans* in relation to the habits of game animals, even during the time of year when the fly is dispersed, is frequently very marked. In this way it appears that the effect of shooting and of the rinderpest might be explained, but it is only comprehensible on the supposition, which the writer believes to be justified, that the fly's ability to perceive its hosts is strictly limited, that it is incapable of following up a trail for any great distance by scent and of attaching itself to and keeping in touch day after day with such game as may be present in the infested area. In the latter part of the dry season its limitations in locating game, except such as may visit its haunts, seem to be obvious, and if, as is probable, this is one of the most important breeding periods, the effect of both shooting and rinderpest seems clear enough.

It may seem improbable that a species of insect should be so ill-provided for taking care of itself under varying conditions as the views outlined in this paper suggest, but if there is one thing more striking than another about the tsetse it is just this disability to adapt itself to a change in its environment, otherwise it would not have retreated before the advance of civilisation, in the absence of any direct effort to drive it back.

Summary.

In the foregoing pages the following tentative views have been put forward in the hope that they may receive either confirmation or criticism from other investigators:

(1). The latter part of the dry season is probably, in general, the most favourable portion of the year to the fly.

(2). The later the onset of the rains the greater the capacity for increase.

(3). Seasons of unusually heavy rainfall are inimical, at least in certain areas.

(4). A series of years of low rainfall is favourable.

(5). Regions where the fly commonly attains the greatest concentration of numbers are the regions where it is most liable to be reduced or to die out, namely, parts of the infested areas where first-grade foci predominate.

(6). In Southern Rhodesia the passage of grass fires has, as a rule, no appreciable effect on the numbers of the fly.

(7). Mopani belts are probably of considerable value to the fly in providing limited areas attractive to game in the wet season, where the grass remains short; they possibly also afford a convenient refuge from grass fires in the dry season.

(8). The fly does not migrate under the stimulus of hunger or in company with game.

(9). The fly as a whole does not follow game about infested areas.

(10). The maximum distance at which a hungry fly readily detects its hosts is a short one, possibly less than 100 yards.

(11). The maximum following distance of the females remains to be determined; the writer is not yet convinced that the females seek animals and human beings only for the purpose of feeding, though this appears probable.

NOTES ON THE MOSQUITOS OF MADAGASCAR, MAURITIUS AND RÉUNION.

By F. W. Edwards,

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Through the kindness of Mons. E. Séguy, of the Muséum d'Histoire Naturelle, Paris, I have recently been enabled to examine a considerable number of mosquitos from Madagascar and the neighbouring French islands, including the types or co-types of all the species described from Madagascar by Ventrillon. As the examination of this material has disclosed the existence of several species hitherto unrecorded from these islands, as well as some new synonymy, it has been thought desirable to record the results at once. In the following pages all the species of mosquitos hitherto known from this region are dealt with. The total number is only 28, as compared with about 180 in the African fauna, so that it is highly probable that further collecting would produce many others.

Anopheles mauritianus, Daruchy de Grandpré & d'Emmerez de Charmoy.

Ambatofanghera and Ambohipomana (*Bouet*, 1905); Tananarive (*Neiret* and *Ventrillon*, 1904 ; *Bouet* 1905).

The commonest *Anopheles* in Mauritius, according to d'Emmerez.

Anopheles maculipalpis, Giles.

Occurs rarely in Mauritius (*d'Emmerez de Charmoy*).

Anopheles squamosus, Theobald.

Cellia tananariviensis, Ventrillon.

According to Ventrillon this is by far the commonest *Anopheles* in Madagascar, and his statement is certainly borne out by its abundance in the collections which I have examined. No constant difference was observable between Madagascan and African specimens.

Anopheles pharoensis, Theobald.

A single specimen, much damaged but undoubtedly this species, from Tananarive (*Ventrillon*, 1905).

Anopheles funestus, Giles.

Four females from Moratsiazo, Lac Itasy (*Bouet*, 1904).

Anopheles marshalli, Theo.

Females from Tananarive (*Neiret*, 1904, and *Ventrillon*, 1905) and Ambohipomana (*Bouet*, 1905).

Anopheles transvaalensis, Carter.

Two females from Tananarive (*Bouet*, 1905).

Anopheles costalis (Loew) Theobald.

Females from Mauritius, where, according to d'Emmerez, the species is common, are in the Paris Museum.

Aëdes (Stegomyia) albopicta, Skuse.

Stegomyia lamberti, Ventrillon, Bull. Mus. Paris, x, p. 552 (1904) and Arch. Parasit. ix, p. 441 (1905).

Stegomyia scutellaris, Theobald et auct. (*nec* Walker).

Ventrillon's types included both sexes, so that the identification of *S. lamberti* is beyond doubt, notwithstanding the fact that Ventrillon states that the female claws are toothed, whereas in all specimens I have examined they are simple. Either Ventrillon made a mistake, or the species is variable in this respect, which is not unlikely.

This species also occurs at Réunion as shown by specimens in the Paris Museum, collected at St. Denis, v-vi, 1913 (*Surcouf*). It has been recorded from Mauritius, where it is said to be very common (*d'Emmerez de Charmoy*). It is surprising that it does not seem to occur on the African mainland, since it has such a wide range throughout the Oriental region.

Aëdes (Stegomyia) argenteus, Poiret (*fasciata*, Fb.).

Culex insatiabilis, Bigot, Ann. Soc. Ent. France, (3) vii, p. 118 (1859).

Bigot's description and figure can apparently only apply to this species, which is common on the islands, especially near the coast (*d'Emmerez de Charmoy*).

Aëdes (Skusea) cartroni, Ventrillon.

Stegomyia cartroni, Ventrillon, Bull. Mus. Paris, xii, p. 143 (1906).

This species, which I had not previously seen, evidently belongs to the sub-genus *Skusea*, although the male is unfortunately unknown. It is very close to *S. pembaensis*, the type of the subgenus, so close indeed that it may eventually prove to be a variety only. However in all the examples of *S. pembaensis* received at the British Museum the abdomen is unbanded dorsally, and the scutellar scales are black, while in the few specimens of *S. cartroni* sent the abdominal segments have narrow pale basal bands, and the few remaining scutellar scales are white.

Aëdes (Ochlerotatus) nigeriensis, Theobald.

Culex fowleri, d'Emmerez de Charmoy, Ann. Trop. Med. ii, p. 258 (1908).

Mr. H. F. Carter informs me that he has examined a male of *C. fowleri* from Mauritius, and established its identity with *O. nigeriensis*, which was already suggested by the author's allusion to the two pale spots on the sixth abdominal tergite of the female.

A female in the Paris Museum from Madagascar may be either this species or *O. fryeri*, Theo.

Orthopodomyia arboricollis, d'Emmerez de Charmoy.

Culex arboricollis, d'Emmerez de Charmoy, Ann. Trop. Med. ii, p. 257 (1908).

Newsteadina arboricollis, Theobald, Ann. Trop. Med. ii, p. 297 (1908).

This species, which is so far only known from Mauritius, is a typical *Orthopodomyia*. I have examined the types in the Liverpool School of Tropical Medicine and find that the female has the very short fourth tarsal joint on the front and middle legs, characteristic of this genus, while the male hypopygium is very similar to that of the other species.

Taeniorhynchus (Mansonioides) uniformis, Theobald.

Females of this species in quite recognisable condition from Ambatofanghera (*Bouet*, 1905). Other specimens, probably of *T.* (*M.*) *uniformis*, were from Morouslava (*Dr. Petit*, 1901).

Taeniorhynchus (Coquillettidia) flavus, Ventrillon.

Culex flavus, Ventrillon (*nec* Motschulsky), Bull. Mus. Paris, x, p. 550 (1904).

Culex grandidieri, Blanchard, Les Moustiques, p. 627 (1905).

Several females, including cotypes of Ventrillon, from Tananarive (*Dr. Ventrillon*, 1905).

This is very close to the African *T. fuscopennatus*, of which it may be a mere local form; the hypopygia are very similar, as is shown by a drawing taken from Ventrillon's male cotype which M. Séguy kindly sent me; this indicates the clasper as having a rather different shape. *T. flavus*, however, in all the examples I have seen, is readily distinguishable by the coloration of the scales on the wing, particularly the apical half. The costa is yellow, with a line of black scales on the outer margin on its basal two-thirds; subcostal and first longitudinal veins predominantly yellow, apically entirely so; stems of fork-cells and tips of veins round wing-tip yellow; remaining veins and fringe mainly black. This description is considerably at variance with that of Ventrillon, but an examination of the cotypes showed that his was inaccurate.

T. fuscopennatus differs in having the dark and light wing-scales fairly evenly mixed, and also in having the integument of the thorax blackish or dark brown, that of *T. flavus* being light brown.

T. aureus, Edw., has an almost greater resemblance even than *T. fuscopennatus*, but it again has a rather differently shaped clasper, and has the costa entirely yellow.

I have adopted the name *flavus* rather than *grandidieri*, because the *Culex flavus* of Motschulsky is probably an *Aëdes*, Ventrillon's later *flavus* being therefore valid in the genus *Taeniorhynchus*.

Culex ventrilloni, sp. n.

♀. *Head* scales narrow, blackish; a rim round the eyes and a longitudinal band down the middle pale golden. Proboscis with a distinct yellow median ring, broader below than above. Palpi one-fourth as long as the proboscis, black, with some white scales about the middle. *Thorax* blackish brown, bristles dark. Prothoracic lobes with a few narrow golden scales; mesonotum with golden and dark brown scales, the former occurring in an indefinite line in the middle and in some large

rather irregular patches on each side on the front half. Scutellum pale, with narrow pale golden scales. Pleurae with four or five small patches of pale ochreous flat scales. *Abdomen* dark brown, tergites with white basal lateral patches and ochreous basal bands, which are broadest in the middle; sternites with dark apical bands. *Legs* black; all the femora black to the base above, ochreous beneath on the basal half. Femora and tibiae all with conspicuous whitish tips, no scattered pale scales. Tarsal joints conspicuously ringed with ochreous at the base only; the rings on the last two joints very narrow. Claws simple; empodia large, nearly as long as the claws. *Wings* with brown scales, those in the lateral series linear. First fork-cell more than twice as long as its stem, its base nearer the base of the wing than that of the second. Cross-veins separated by rather more than the length of the posterior.

Length, 6 mm.

MADAGASCAR: Tananarive, 1904, 1♀ (*Dr. Neiret*) and 1905, 2♀ (*Dr. Ventrillon*).

Type in the Paris Museum; paratype in the British Museum.

This species is noteworthy for the ornamentation of the head, the basally ringed tarsal joints, and the large empodia. It has no near ally among the described African and Oriental species, and in the absence of the male it is impossible to say in what subgenus it should be placed. Possibly it may be a *Lutzia*.

Culex annulitarsis, Macquart.

The brief description of Macquart will not apply to any known species. It was referred by Theobald to the synonymy of *Stegomyia fasciata*, but Macquart's description of the legs (hind tibiae with a broad white ring before the tip; hind metatarsi white, with a narrow black ring) makes the reason for this far from obvious.

Culex (Lutzia) tigripes, Grandpré & Charmoy.

Tamatave (*Jaillet*). Described from Mauritius.

Culex (Culex) quasigelidus, Theobald.

Pseudoheptaphlebomyia madagascariensis, Ventrillon.

This synonymy, previously given by me, can be confirmed from an examination of the types, although Ventrillon's description does not agree. Additional specimens are from Ambohipomana (*Bouet*, 1905) and Tananarive (*Waterlot*, 1916).

Culex (Culex) giganteus, Ventrillon.

Culex giganteus, Ventrillon, Bull. Mus. Paris, xii, p. 100 (1906).

Culex neireti, Ventrillon, Bull. Mus. Paris, xii, p. 103 (1906).

The original description of *C. giganteus* and *C. neireti* are very similar, except as regards the size given and the markings of the thorax. Study of the types shows that the insects are actually the same, the differences in the description being due to inaccurate observation. In particular, Ventrillon's measurement of 10 mm. body length for *C. giganteus* is a considerable exaggeration, the actual length being only about 6 mm., excluding the proboscis. Additional specimens are from Ambatofanghera and Ambohipomana (*Bouet*, 1905).

The species is a close ally of the African *C. annulioris*, Theo., differing chiefly in the greater extension of the yellow markings of the abdomen; and in some small details of the structure of the male hypopygium, notably the shorter and stouter

basal arms of the tenth sternites. Perhaps the single specimen of *C. annulioris* recorded by d'Emmerez de Charmoy (Ann. Trop. Med. ii, p. 260) may have been *C. giganteus*.

Culex (Culex) sitiens, Wied.

Culex ronaldi, d'Emmerez de Charmoy, Ann. Trop. Med. ii, p. 259 (1908).

Recorded from Mauritius, but not from Madagascar, where however it is very likely to occur, since it has a wide distribution from East Africa to Australia.

Culex (Culex) univittatus, Theobald.

Heptaphlebomyia montforti, Ventrillon, Arch. Parasit. ix, p. 448 (1905).

My previous statement as to the identity of *C. univittatus* and *H. montforti* is confirmed by an examination of the male hypopygium of one of Ventrillon's specimens.

Culex (Culex) pipiens, L.

Tananarive (*Neiret*, 1904 ; *Ventrillon*, 1905).

This record forms a further notable extension of the known range of this species, which until recently was thought to be confined to the temperate regions of the northern hemisphere. It is now known also from South and East Africa and from the Argentine.

Culex (Culex) ? laurenti, Newstead.

Some female specimens from Tananarive (*Neiret*, 1904) are perhaps this species, though it is possible that they may belong to the variety of *C. pipiens* with an unbanded abdomen, which is known from East Africa and from the Mediterranean region.

Culex (Culex) fatigans, Wied.

Culex cartroni, Ventrillon, Bull. Mus. Paris, xi, p. 429 (1905).

Culex anxifer, Bigot, Ann. Soc. Ent. France, (3) vii, p. 117 (1859).

The hypopygium of Ventrillon's type male was mounted and proved it to be this species. Other specimens from Réunion (*Surcouf*). The commonest mosquito in Mauritius (*d'Emmerez de Charmoy*).

Bigot's description of *C. anxifer* is unrecognisable, and he had no type, but Blanchard has referred his name to the synonymy of *C. fatigans*, and there seems no sufficient reason to dispute this.

Culex (Culex) argenteopunctatus, Ventrillon.

Heptaphlebomyia argenteopunctata, Ventrillon, Arch. Parasit. ix, p. 446 (1905).

Heptaphlebomyia kingi, Theobald, Ann. Trop. Med. vii, p. 601 (1913).

A number of females, all in poor condition, some barely recognisable, from Tananarive (*Ventrillon, Bouet, Guérin Méneville, Waterlot*).

A male in the British Museum named by Ventrillon lacks the abdomen, but fortunately there is another, in perfect condition, from the Gold Coast (*Dr. A. Ingram*). I have mounted the hypopygium of this and find that it is a true *Culex* bearing a rather considerable resemblance to *C. decens*, Theo. The two silvery spots on the thorax are remarkable and absolutely diagnostic, being comparable only with certain species of *Aëdes*, e.g., *punctothoracis*, Theo.

Uranotaenia neireti, sp. n.

♂ *Head* scales and integument blackish, a spot of pale blue in the middle in front, and another on each side at the eye-margin. Proboscis slightly longer than the abdomen, slightly swollen at the tip. *Thorax* brown, lower half of pleurae somewhat lighter. Prothoracic lobes with light blue scales; proepimera bare, lower half blackish. Mesonotum with narrow dark brown scales, those on the scutellum flat; no lateral line of flat scales. A spot of pale blue scales in middle of pleurae, and a few more scattered on sternopleura; integument darker on each side of the blue spot. *Abdomen* dark brown above, lighter brown beneath. *Legs* dark brown; coxae and bases of femora ochreous; tip of third and whole of fourth tarsal joint of hind legs whitish; fifth darker. Tarsi and claws normal. *Wings* with brown scales only, those towards the apex rather narrowly spatulate. Upper fork-cell more than half as long as its stem.

Length, 3 mm.

MADAGASCAR: 1 ♂ 1 ♀ (*Dr. Ventrillon*), without exact locality, labelled "*Ficalbia neireti*. Type: Ventr." Type ♂ in the Paris Museum. The female and a second male from Tananarive (*Ventrillon*, 1905) have the blue scales replaced by greyish white, probably owing to fading.

Eretmopodites quinquevittatus, Theobald.

Eretmopodites condei, Ventrillon, Arch. Parasit. ix, p. 144 (1905).

No males were present, and the few females in Ventrillon's collection were rather rubbed, but the above synonymy, previously suggested by me, is highly probable.

NOTES ON THE NOMENCLATURE OF CERTAIN AFRICAN TABANIDAE (SUB-FAMILY PANGONIINAE), WITH DESCRIPTIONS OF A NEW GENUS AND NEW SPECIES.

By Major E. E. Austen, D.S.O.

Some six years ago, it was correctly pointed out by Brèthes (Bull. Soc. Ent. de France, 1914, p. 59) that the generic designation *Diatomineura*, Rond. (Archiv. Zool. Anat. Fisiol. iii, p. 84, 1864), is a synonym of *Osca*, Walk. (Ins. Saund., Diptera, Part i, p. 10, 1850—*nec* Walk., 1864, *nec* Stål, 1871). The first species mentioned by both Walker and Rondani is *Pangonia depressa*, Macq. (=*Erephopsis lata* (*Tabanus latus*), Guér.), and this species is designated by Brèthes as the genotype. *Erephopsis lata*, Guér., of Kertész's Catalogus Dipterorum (iii, p. 165, 1908), must therefore be known henceforth as *Osca lata*, Guér., and the South African *Tabanus barbatus*, L. (*Pangonia barbata*, Auct.), and *Pangonia fulvifascia*, Walk., must be transferred to the genus *Osca*.

It is not, however, simply a question of substituting *Osca* for *Diatomineura*, since *Osca lata*, Guér., is certainly not congeneric with any, or at any rate with the majority of the species at present grouped under *Diatomineura*, sub-genus *Corizoneura*. So far as regards Ethiopian and Oriental species, the difficulty can be met by, as is hereby proposed, raising *Corizoneura*, Rond. (*loc. cit.*, p. 85) to generic rank, designating as its genotype the first species mentioned by Rondani under *Corizoneura*, viz., *Tabanus aethiopicus*, Thunb. (syn. *Pangonia appendiculata*, Macq.), and erecting a new genus, which may be termed *Buplex*,* for certain Ethiopian species included by Kertész under the *Corizoneura* division of *Diatomineura*, but not congeneric with *C. aethiopica*, Thunb. The arrangement indicated may be expressed in tabular form as follows.

Eyes bare; first posterior cell open.

Ocelli absent; face, especially in ♀, markedly produced (forming a snout-like prolongation), with a shining callus, or at least a more or less shining area, on each side; proboscis long or very long, usually much longer than thorax including scutellum, and generally horizontal or nearly so; distal extremities of first and second joints of front tarsus in ♂ generally each produced above into a tongue- or lappet-like process, which, in case at least of second joint, is often of considerable relative length .. .. *Corizoneura*, Rond.

(Genotype, *Tabanus aethiopicus*, Thunb.,—syn. *Tanyglossa aethiopica*, Thunb.; *Pangonia appendiculata*, Macq.).

Ocelli usually present; face not produced, merely convex, and without shining callus or area on each side; proboscis of only moderate length, shorter than or about as long as thorax including scutellum, and generally slanting downwards at an angle of 45°; distal extremities of tarsal joints never produced .. .. ..

Buplex, gen. nov.

(Genotype *Pangonia suavis*, Lw.).

* βου-πλήξ ὁ, an ox-goad.

Among other species referable to the new genus thus briefly characterised are *Pangonia brunnipennis*, Lw., *P. subfascia*, Walk., *Corizoneura albifacies*, Ric., *C. dissimilis*, Ric., and the new species described below.

The genus *Corizoneura*, Rond., as defined and restricted above, includes, in addition to the genotype and the new species described in this paper :—*Diatomineura virgata*, Austen ; *D. inornata*, Austen ; *D. neavei*, Austen ; *Pangonia sagittaria*, Surc.; *Corizoneura distincta*, Ric. ; *Pangonia lateralis*, Wied. (Fabr. ?) ; *Diatomineura hastata*, Austen ; *D. lineatithorax*, Austen ; *D. penetrabilis*, Austen ; *Corizoneura pallidipennis*, Ric. ; and *C. umbratipennis*, Ric. The foregoing all belong to the Ethiopian Region, and congeneric with them are the Oriental *Pangonia taprobanes*, Walk. (syn. *P. rufa*, Macq.), and *P. longirostris*, Hardw.

Another change which may as well be made now, since in any case it is almost certain to be effected sooner or later, is the replacement of Macquart's generic designation *Cadicera* by *Phara*, Walk. (Ins. Saund., Diptera, Part i, p. 9, 1850). The latter name, accompanied by a brief diagnosis, was applied by its author to one of " several groups or subgenera " of *Pangonia*, Latr. ; eighteen species were mentioned under *Phara*, the first three of these being, in the order given, *Pangonia melanopyga*, Wied., *P. chrysostigma*, Wied., and *P. crassipalpis*, Macq. The present writer hereby proposes to regard *Pangonia melanopyga*, Wied., as the genotype of *Phara*, Walk. ; to raise the latter to generic rank ; and to restrict it so as to include besides the genotype, among the species mentioned under *Phara* by Walker, only *Pangonia chrysostigma*, Wied., and *P. crassipalpis*, Macq., since these three species are obviously congeneric. *Phara*, Walk., therefore, as thus restricted, replaces and must be substituted for *Cadicera*, Macq. (Mém. Soc. Imp. des Sc. Lille, 1854, (2) p. 42, 1855), founded for *C. rubramarginata*, Macq. (*loc. cit*, p. 23).

Except where otherwise stated, the types of the new species described in the following pages are in the British Museum (Natural History).

Genus **Buplex**, nov.

Buplex fuscinervis, sp. n.

♀.—Length (2 specimens) 12 to 13 mm. ; width of head 4 to 4·2 mm. ; width of front at vertex 0·8 mm. ; length of proboscis 3·4 to 3·5 mm. ; length of wing 12·4 to 12·5 mm.

Body, except certain areas at sides of abdomen, black above, with scutellum, lateral borders and three narrow longitudinal stripes on scutum, and deep posterior borders to abdominal segments smoke-grey or pale smoke-grey pollinose ; lateral extremities of tergites of first (visible) and second abdominal segments smoke-grey, more or less tinged with ochraceous tawny owing to the subjacent ground-colour ; wings with base, costal and sub-costal cells and stigmatic area ochreous, veins after first longitudinal in distal half (from base of discal cell onwards) dark brown, and for most part more or less strongly suffused with mummy brown.*

*For names and illustrations of colours used for descriptive purposes in the present paper, *see* Ridgway, " Color Standards and Color Nomenclature " (Washington, D.C. Published by the Author, 1912).

Head: ocelli present; face, jowls and lower half of front light buff pollinose, clothed with pale yellowish hair, occiput smoke-grey pollinose, and likewise clothed with pale yellowish hair; upper part of front with a pair of narrow, blackish stripes, commencing at ocellar tubercle, descending somewhat lower than middle and diverging below, each stripe clothed with short, curving black hairs, interspersed with some glistening yellowish hairs; *palpi* clothed with yellowish hair, longer on proximal than on terminal joint, latter russet or ochraceous tawny, proximal joint mouse-grey, russet towards distal extremity; first and second joints of *antennae* clothed partly with yellowish hair, partly with black hair, first joint mouse-grey or deep neutral grey, second joint russet (third joint missing in case of type). *Thorax*: smoke-grey longitudinal stripes on dorsum extending from front to hind margin of scutum, confluent posteriorly; transverse suture smoke-grey, forming a connection between lateral border and outer smoke-grey stripe on each side; pleurae and pectus light greyish olive pollinose; thorax clothed with yellowish hair, black stripes on dorsum clothed posteriorly with fine black hair. *Abdomen*: black area on first (visible) and second tergites restricted to a transverse band occupying middle third of anterior half, with rounded posterior angles in each case, and, especially on second segment, indented in middle line behind; lateral margins of fourth and following tergites, and lateral extremities of hind border of third tergite ochraceous tawny, though normally concealed by hair and smoke-grey pollen; seventh tergite entirely grey; lateral extremities and hind borders of all tergites clothed with glistening hair, longer and ochreous on lateral extremities of second and two or three following segments, shorter and paler elsewhere; black area on second tergite clothed with yellowish hair, corresponding areas on two following tergites clothed with short, erect black hair; venter smoke-grey, clothed with appressed, glistening, cream-coloured hair; second sternite with a transversely elongate, somewhat reniform, fuscous black blotch in middle line, resting on or close to anterior border and confined to anterior half of segment, third and three following sternites each with a sooty black, transverse band on front border, widely separated in each case from lateral margins, and from twice to four times deeper on third than on either of the other sternites, these bands clothed with short, erect, black hair. *Wings* with auxiliary and first longitudinal veins, second longitudinal from base to a little beyond origin of third longitudinal, praefurcal portion of fourth longitudinal, and extreme bases of fifth and sixth longitudinal veins ochreous; veins otherwise more or less dark brown. *Squamae* cream-buff. *Halteres* maize-yellow, knobs sometimes darker (mummy-brown) at base. *Legs*: coxae and femora deep mouse-grey, clothed with yellowish hair; tibiae and tarsi clove-brown, clothed with minute black hairs, tarsal joints sometimes paler towards base.

South Africa (Cape Province); type and para-type from Bizana, East Pondoland, 1912(—*Goodall*: presented by Mr. T. B. Goodall).

The species described above shows a decided resemblance to *Buplex* (*Pangonia*) *suavis*, Lw., but, apart from its smaller size, is distinguishable, *inter alia*, by the presence of the two blackish stripes on the front; by the outer two of the three longitudinal smoke-grey stripes on the disk of the scutum being narrower; by the absence of a brown blotch near the tip of the wing, above the fork of the third longitudinal vein; and by the veins in the region of the discal cell being suffused with mummy-brown.

Genus **Corizoneura**, Rond.

Corizoneura formosa, sp. n.

♂.—Length (4 specimens) 20 to 21·4, mm. ; width of head 6 to 6·4 mm. ; distance from upper margin of occiput to anterior extremity of face 5 to 5·25 mm. ; length of proboscis 13 to 15 mm. ; length of wing 17·4 to 18 mm. ; wing-expanse 21·5 to 23 mm.

Dorsum of thorax dark olivaceous black, with broad smoke-grey lateral borders clothed with cream-coloured hair, and with two narrow, smoke-grey, admedian, longitudinal stripes ; dorsum of abdomen ochraceous tawny, with distal extremity (fifth to seventh segments) infuscated (iron-grey to olivaceous black), a large black median blotch on each of the first four visible segments, and fourth segment bordered posteriorly with appressed, silvery white and ochreous hair ; venter cinnamon-buff or cinnamon-coloured, with last three segments sometimes mouse-grey and lateral extremities of first visible scute neutral grey ; wings with a sepiaceous tinge ; processes at tips of first and second joints of front tarsus in ♂ very long.

Head : face bluntly conical, moderately produced ; front and face (except sides of facial prominence below, which are clove-brown and shining) pinkish buff pollinose, front and borders of face adjacent to eyes clothed with longish, cream-buff hair ; occiput smoke-grey, clothed above with cream-buff, below with whitish hair ; jowls and basi-occipital region pale smoke-grey, clothed with long whitish hair ; *palpi* russet, dark brown on outer side, proximal joint with a bunch of whitish hair at base below ; first and second joints of *antennae* isabella-coloured pollinose, clothed above and below with longish hair, generally black or blackish but sometimes mainly cream-coloured on first joint, third joint ferruginous or vinaceous rufous, clove-brown at tip. *Thorax* : dorsum, including scutellum, clothed for most part with somewhat appressed, cream or cream-buff-coloured hair, often but little visible when regarded from above, hair above lateral borders between bases of wings often largely or mainly dark brown, pleurae and pectus clothed with fairly long, whitish or yellowish white hair. *Abdomen* : except on first (visible) tergite, on which median blotch extends to or is but narrowly separated from hind margin, black median blotches, which rest on front margin, do not reach hind border ; posterior angles of first and second tergites clothed with yellowish or whitish hair, hind border of second tergite with a patch of glistening, appressed, ivory-yellow or cream-buff-coloured hair in middle line, light-haired hind border of fourth tergite expanded in middle line and at each extremity, lateral extremities of sixth and seventh tergites generally clothed with glistening silvery white hair, lateral extremities of second to fourth tergites inclusive, except as already stated, clothed with black hair, ochraceous tawny area of first and second tergites clothed mainly with minute, glistening, appressed, ochreous hairs, corresponding area on third and fourth tergites clothed with minute black or blackish hairs, fifth and sixth tergites (except lateral extremities in case of latter) clothed with black hair ; venter clothed with minute, appressed, glistening, cream-buff-coloured hairs, fifth sternite sometimes largely clothed with minute, black or blackish hairs. *Wings* : veins sepia-coloured, adjacent membrane suffused with same colour at base, and to a less extent at level of proximal extremity of discal cell. *Squamae* waxen ochraceous buff or pale orange-yellow, fringed with minute yellowish hairs.

Halteres light chestnut-brown, tips of knobs light buff or light ochraceous buff. *Legs* : coxae neutral grey, clothed with whitish hair, which is longer on front pair ;

femora russet (extreme tips ochraceous buff), clothed mainly with whitish or yellowish white hair, antero-inferior area of front pair with minute, erect, blackish hairs ; front and middle tibiae ochraceous buff, clothed with minute, glistening, yellowish or ochreous hairs, hind tibiae and hind tarsi russet-brown, clothed with black hair, distal extremities of hind tarsal joints blackish ; front tarsi ochraceous buff or ochraceous tawny, distal extremities of last three joints dark brown, body of second joint very short, tongue-like process at its distal extremity very long (longer than following joint), process at end of first joint overlapping and closely applied to first two-thirds of following joint ; first joint of middle tarsi cream-buff, remaining joints dark brown or mummy-brown, blackish brown at tips.

South Africa (Cape Province) : type and three para-types from Deelfontein, 7.xii.1902 (presented by *Colonel Sloggett, A.M.S.*—now *Lieut.-General Sir A. T. Sloggett, K.C.B., K.C.M.G.*).

This handsome species presents a decided resemblance to *Corizoneura aethiopica*, Thunb., another inhabitant of the South African portion of the Ethiopian Region, but can at once be distinguished, *inter alia*, by the presence of the conspicuous, smoke-grey, admedian, longitudinal stripes on the dorsum of the thorax.

Corizoneura schwetzi, sp. n.

♂ ♀.—Length, ♂ (6 specimens) 16·4 to 18 mm., ♀ (6 specimens) 16 to 18·6 mm. ; width of head, ♂ just over 5 to 5·4 mm., ♀ 5·2 to 5·75 mm. ; distance from upper margin of occiput to anterior extremity of face, ♂ 4·2 to 4·5 mm., ♀ 4·5 to 4·8 mm. ; width of front of ♀ at vertex 0·6 to 0·75 mm. ; length of proboscis, ♂ 15 to 15·25 mm., ♀ 11·75 to 13·75 mm. ; length of wing, ♂ 15 to 15·2 mm., ♀ 15·5 to 17·25 mm.

Dusky species, with base of abdomen paler ; dorsum of thorax dark brownish olive, with a broad, indistinct, blackish brown longitudinal stripe along each side above lateral margin, a narrow, elongate, pale spot (composed of Naples yellow or cream-buff hair) above base of each wing in front of postalar callus, and a short but conspicuous stripe of black hair between base of costa and humeral callus on each side ; dorsum of abdomen with first two (visible) segments cinnamon-buff or tawny olive in ♂, ochraceous tawny in ♀, ♂ with a blackish brown median triangular spot at base of second segment, tergites of third and following abdominal segments blackish brown or black, fourth segment posteriorly with a conspicuous transverse band of appressed, glistening, silvery white hair ; venter abruptly bicoloured, proximal portion as far as base of third (visible) sternite, ivory-yellow, cream or cream-buff-coloured, remainder blackish brown ; wings strongly and uniformly tinged with sepia.

Head drab pollinose, posterior orbits paler (light greyish olive above, smoke-grey or pale smoke-grey below), shining callus on each side of face below antenna black, sharply defined, sides of face below calli more or less dark brown or blackish brown owing to ground-colour showing through pollinose covering, lower border of sides of face in ♂ shining blackish brown, deeper posteriorly, distal extremity of face in ♀ shining blackish brown, sparsely clothed with drab pollen, in both sexes a more or less distinct, somewhat triangular, olive-buff or pale olive-buff, pollinose spot on each side of lower part of front, between base of antenna, margin of eye and shining callus ; front in ♀ with following series of dark brown marks—

a transversely oblong spot occupying ocellar region of vertex but not extending to eyes, a pair of somewhat guttate spots in centre of front, indistinctly connected with foregoing spot but likewise not in contact with eyes, and an oblique spot on each side below, extending from base of antenna to eye, above the light (olive-buff or pale olive-buff) spot already mentioned; front in ♂ clothed with black hair, in ♀ with shorter blackish hair, mingled with paler hair in upper portion, posterior orbits in both sexes fringed above with yellowish hair and below with longer whitish hair, basi-occipital region and jowls densely clothed with fairly long, whitish hair, lower borders of sides of face clothed posteriorly with black or blackish hair, more conspicuous in ♂ than in ♀; *palpi* russet-brown in ♂, russet in ♀, terminal segment (elongate and very narrow in ♂) clothed with minute black or blackish hairs, proximal segment, especially in ♀, clothed below with longer hair, brownish or blackish brown anteriorly, yellowish or whitish posteriorly; *antennae* russet, first and second joints more or less smoke-grey pollinose, clothed with black hair. *Thorax*: dorsum clothed anteriorly with silky, tawny olive or ochreous hair, posteriorly, including base of scutellum, with fine, erect, black hair, postalar calli, and scutellum, except as stated, clothed with Naples yellow or cream-buff hair, hairy covering of central portion of dorsum visible only when viewed from side; pleurae and pectus clothed with longish hair, for most part cream-buff (whitish on propleurae) in colour, a tuft of black hair (less conspicuous in ♀, in which sex it is often much reduced) below base of wing on each side; sternopleurae in ♂ sometimes clothed mainly with black or blackish hair. *Abdomen*: hind border (distal third or rather less) of second (visible) tergite clothed with minute, appressed hairs, which are silvery white or whitish at and towards lateral extremities of segment, and sparser and more yellowish (often glistening cream-buff) in vicinity of median line (owing to paler ground colour, whitish transverse band thus formed is, except at lateral extremities, less conspicuous than corresponding band on fourth segment); base of first (visible) tergite with a blackish brown, median area, extending beyond scutellum, but not or barely reaching hind margin except in middle line in ♂, in which sex it is more or less distinctly connected with triangular spot on second segment; blackish brown median triangle on second tergite in ♂ with its base resting on or close to anterior margin, and its apex reaching or extending somewhat beyond middle of segment; third tergite sometimes irregularly paler (cinnamon-brown) at base and on hind border; hairs in silvery white transverse band on fourth tergite somewhat yellowish in vicinity of middle line; seventh tergite in ♀, as well as frequently hind borders of fifth and sixth tergites, often dull fuscous; lateral extremities, or at least posterior angles, of fifth and sixth tergites each clothed with a prominent tuft of silvery white hair; posterior angles, as well as in ♀ hind margin of first (visible) tergite clothed with shining ochreous or pale ochraceous orange hair; dorsum of abdomen except as already stated clothed with minute, appressed, black hairs; first (visible) sternite bare, second sternite clothed with minute, appressed, glistening cream-coloured hairs (anterior border of second sternite fringed with fine, erect, black or blackish hair, shorter and less developed in ♀ than in ♂, in which sex fine, recumbent, black hairs are also present among the cream-coloured hair, especially towards lateral extremities of the scute), blackish brown portion of venter clothed with black hair, among which a few pale hairs are occasionally present

on one or more of fourth and following segments. *Wings*: appendix to anterior branch of third longitudinal vein, though of variable length, as a rule relatively somewhat long. *Squamae* isabella-coloured. *Halteres* mummy-brown, knobs in ♀ often paler (cream-buff) at tip. *Legs*: front coxae neutral grey, clothed with cream-coloured or cream-buff hair, middle and hind coxae deep neutral grey or dark neutral grey, clothed with black hair, hind coxae in ♀ also with some yellowish hairs; hind femora in ♂ and bases of front and middle femora in same sex blackish brown, front and middle femora in ♂ except at base russet-brown or cinnamon-brown, all femora in ♂ clothed with black hair, femora in ♀ paler, and clothed largely with ochraceous buff or ochreous hair as well as with black hair; coloration of tibiae and tarsi and of their hairy covering alike in both sexes, front and middle tibiae ochraceous buff or ochraceous tawny, clothed with minute, appressed glistening ochraceous buff hair, hind tibiae and hind tarsi blackish brown, clothed with black hair, tips of second and two following tarsal joints clothed below with ferruginous hair, similarly coloured hair also largely present, at least in ♀, on under side of first tarsal joint, front and middle tarsi ochraceous tawny, clothed above with black hair, last joint in each case, as well as distal extremities of preceding joints mummy-brown, processes at tips of first and second joints of front tarsi in ♂ of moderate size, in neither case reaching distal extremity of following joint.

Belgian Congo (North Katanga) and Tanganyika Territory. Typical series from Kakanu (between 15 and 16 miles south of Kisengwa, R. Lomami), N. Katanga, vi. 1918 (*Dr. J. Schwetz*). Type of ♂, type of ♀, 36 ♂ and 2 ♀ para-types, in Musée Royal d'Histoire Naturelle de Belgique (Brussels); 6 ♂ and 6 ♀ para-types, in British Museum (Natural History)—presented by M. G. Severin; 1 ♀, from Tanganyika Territory (formerly German East Africa), 30° 55′ E. Long., 2° 5′ S. Lat., 16. vi. 1916 (*Dr. G. D. H. Carpenter*), in British Museum (Natural History), presented by Imperial Bureau of Entomology.

This fine species, with which the author has much pleasure in connecting the name of its discoverer (the well-known student of tsetse-fly bionomics in North Katanga), was met with by the investigator in question in large numbers in the vicinity of Kakanu.* On 6th June 1918, in a belt of forest several hundred metres in breadth and about 3¾ miles from Kakanu, Dr. Schwetz's native carriers succeeded in catching some 2,000 specimens of *C. schwetzi*, from 80 to 90 per cent. of which were males.† Unlike *Corizoneura inornata*, Austen (see below), which is found in the open, *C. schwetzi* does not occur outside the forest. According to Dr. Schwetz,‡ in the case of the present and the following species (*C. inornata*, Austen) at least, the labium itself is the piercing organ, and in the act of biting is thrust by the insect deeply into the skin of its victim. It is therefore interesting and possibly suggestive to note that, in the ♀ taken by Dr. Carpenter in Tanganyika Territory, the labium

* *Cf.* Schwetz, "Dix Jours d'Observations sur les Moeurs de la 'Pangonia zonata' et de la 'Pangonia oldii' (Deuxième Note)": *Revue Zoologique Africaine*, vii, pp. 92–106 (1919).—*Cf.* also the earlier paper by the same author, "Quelques Observations Préliminaires sur les Moeurs de la 'Pangonia zonata'": *ibid.*, pp. 46–54. In both of the memoirs cited *Corizoneura schwetzi* is referred to as *Pangonia oldii*, while the species termed *Pangonia zonata* is really *Corizoneura inornata*, Austen.

† *Cf.* Schwetz, *loc. cit.*, p. 103.

‡ See below, p. 147.

only projects 7·5 mm. beyond the extremity of the clypeus, exceeding the length of the labrum-epipharynx and the other mouth-parts by little more than the labella, while the proximal portion of the labium is bent backwards underneath the head, and beneath the cleft between head and thorax forms an angle of 45° with the distal portion.

Although superficially presenting a decided resemblance to *Pangonia oldii*, Austen, *Corizoneura schwetzi* can be distinguished from that species *inter alia* by the processes (entirely wanting in *P. oldii*) at the tips of the first and second joints of the front tarsi in the ♂; by the much greater development of the dark spot (often scarcely more than vestigial in *P. oldii*) at the base of the second abdominal tergite in the same sex; and in both sexes by the short stripe of black hair on each side of the dorsum of the thorax, in front of the base of the wing.

From *Corizoneura inornata*, Austen, apart from obvious differences in coloration, especially the sharply bicoloured venter of the species just described, *C. schwetzi* is distinguished by the inferior development of the processes at the tips of the first and second joints of the front tarsi in the ♂. Whereas in *C. inornata* ♂ each of these processes is so long as to project beyond the tip (excluding the process in the case of the second segment) of the following joint, in *C. schwetzi* ♂ neither process reaches the tip of the succeeding joint.

Corizoneura inornata, Austen.

Diatomineura inornata, Austen, Bull. Ent. Res. i, p. 282 (1911).

This species was described from a single ♀, obtained in September 1907, in S. Katanga, Belgian Congo, between Bunkeya and Kambove, at an altitude of 3,500 ft., by *Dr. Sheffield Neave*. The kindness of Dr. J. Schwetz, in presenting to the British Museum (Natural History) a large number of specimens of both sexes, now renders it possible to indicate the distinctive characters of the ♂.

C. inornata, Austen, ♂.—Apart from ordinary secondary sexual characters, agreeing generally with the ♀ except as follows. *Head*: hair clothing jowls and basi-occipital region often hoary or nearly white; first two joints of *antennae* clothed mainly with black hair. *Thorax*: pleurae on each side with a tuft of black hair below base of wing. *Abdomen*: first (visible) tergite with a median brownish black area at base, projecting somewhat beyond scutellum, but not reaching hind margin; second tergite with a conspicuous, median, brownish black, triangular spot resting on front margin, and varying in size in different individuals, but not extending beyond middle of segment, if so far; fifth and sixth tergites mainly brownish black, blackish brown or clove-brown, each of the two preceding tergites often with an ill-defined median blotch of same colour occupying anterior two-thirds. *Legs*: front and middle femora clothed largely with black hair, at least towards base, hind legs clothed mainly with black hair, processes at tips of first and second joints of front tarsi very long, in each case projecting beyond end of following joint (excluding process in case of second segment).

In the papers already referred to,* under the name "*Pangonia zonata*," Dr. Schwetz has furnished a series of interesting field notes on the behaviour of this

* P. 145, note.*

species, which, at the end of May 1914 and at the close of the same month and beginning of June 1918, was found by him in great abundance in the vicinity of Kakanu, N. Katanga, at and about the flowers of *Acanthus montanus* (termed by the natives "Nafimbia"), which grows in sheets in open spaces outside the forest. According to Dr. Schwetz, the existence of *C. inornata* is "intimately connected" with that of the flowers in question, the nectar of which is imbibed by both sexes, though the females also suck blood on occasion. It is interesting to note that, having in a number of cases observed the process of sucking blood by females of this and the foregoing species (*Corizoneura schwetzi*, Austen), Dr. Schwetz states that, in these PANGONIINAE at any rate, the actual piercing organ is the *proboscis* (labium) itself, which is "evidently sufficiently rigid" to penetrate the human integument, and is driven by the insect "fairly and squarely into the skin to the extent of one-third or one-half of its length. .

Genus **Pangonia**, Latr.

Pangonia discors, sp. n.

♀.—Length (1 specimen) 19·6 mm.; width of head 5·6 mm.; width of front at vertex 0·75 mm.; distance from upper margin of occiput to anterior extremity of face 4·5 mm.; length of proboscis 5·5 mm.; length of wing 17·6 mm.

Deep black, somewhat shining; first (visible) and second abdominal tergites densely covered with pale gull-grey pollen, and thickly clothed with closely appressed, silvery white hair; area beneath scutellum free from pollen and clothed with black hairs, some black hairs also present in middle line on anterior border of second tergite, latter likewise exhibiting a broad, median, triangular area (its base resting on front margin, its apex directed backwards and reaching beyond middle of segment) which, like front border of same segment, has a blackish look owing to pollen on it being thinner than elsewhere; lateral extremities of second tergite clothed with black hair; wings mummy-brown, proximal half (as far as base of discal cell) and stigma pale orange-yellow or light orange-yellow.

Head: ocelli wanting; face moderately prominent, front above relatively somewhat narrow; area from middle of front to anterior margin of clypeus olive-buff, upper half of front fuscous black, sides of face clove-brown, occiput and basi-occipital region smoke-grey or pale smoke-grey, jowls clothed with yellowish cream-coloured hair; *palpi* clove-brown, terminal joint elongate, tapering to a point and somewhat curved; first and second joints of *antennae* dark mummy-brown, clothed with minute black hairs mixed with some minute yellowish hairs, first joint short, expanded portion of terminal joint cinnamon-brown (terminal portion missing in case of type). *Thorax*: postalar calli chestnut-brown; dorsum including scutellum clothed with short black hair, which on front border of scutellum is interspersed with minute, glistening, appressed, golden hairs, a few golden hairs also on upper portion of swelling occupying depression at each end of transverse suture, hair on pleurae and pectus entirely black or fuscous black. *Abdomen*: third (visible) and following tergites clothed with appressed, black hair; venter, except second sternite, clothed with appressed, black or brownish black hair, ventral surface of second segment

* *Cf.* Schwetz, Rev. Zool. Africaine, vii, pp. 101–102 (1919).

clothed with minute, appressed, glistening, yellowish white hairs, fore border and lateral extremities clothed with black hairs. *Wings*: transition from orange-yellow proximal to mummy-brown distal portion sharply marked, at least in case of type. *Squamae* ivory-yellow. *Halteres* ochraceous buff, stalks and knobs towards base brownish. *Legs*: coxae and femora dark brown or blackish brown, clothed with black hair, which on under side of hind femora is mixed with a certain number of minute, glistening tawny hairs, and on anterior surface of front coxae with a few golden hairs; tibiae and tarsi russet, clothed for most part with minute, appressed, glistening, ochraceous tawny hairs, last three joints of tarsi dark brown above.

Angola (*J. J. Monteiro*).

Pangonia discors resembles and is closely allied to the East African *P. beckeri*, Bezzi, but is readily distinguishable owing to, *inter alia*, its more prominent face and narrower upper part of the front, the entire absence of white hair on pleurae, postalar calli and front coxae, and the distal portion of the abdomen being entirely black and covered with black hair, instead of having the tip ochraceous tawny and clothed with glistening ochraceous orange or ochreous hair.

Pangonia lautissima, sp. n.

♂♀.—Length, ♂ (9 specimens) 17 to 19 mm., ♀ (3 specimens) 16 to 17·4 mm.; width of head, ♂ just under 5 to 5·4 mm., ♀ 5 to 5·6 mm.; width of front of ♀ at vertex just under 1 to 1·2 mm.; length of proboscis, ♂ just under 4 to 4·25 mm., ♀ 3·4 to 4·2 mm.; length of wing, ♂ 14 to 15·2 mm., ♀ 14 to 15·6 mm.

Shining black; *basi-occipital region clothed and lower halves of posterior orbits fringed with orange-buff hair, and patches of similarly coloured hair on pleurae*; *wings with base and a deep anterior border extending to end of third costal cell ochraceous orange, and remainder of surface uniformly brownish black, with a strong purplish metallic sheen.*

Head black, frontal triangle in ♂ and region of subcallus (area immediately above bases of antennae) in ♀ shimmering silvery white pollinose, a similar pollinose patch (clothed with a few whitish hairs, and usually more distinct and sharply defined in ♀ than in ♂) on each side of upper part of face in both sexes; face in both sexes tumid below antennal prominence, then indented or somewhat receding, not produced into a nose-like prolongation, front in ♀ deeply furrowed; occiput pallid neutral grey pollinose, clothed with whitish hair, posterior orbits silvery white, their upper halves fringed behind with minute blackish hairs; *palpi* and *antennae* black, proximal joints of both sparsely clothed with short, black or blackish hairs, third joint of antennae from certain aspects appearing dark olive-grey, mouse-grey or brownish grey pollinose. *Thorax*: dorsum including scutellum clothed with short black hair, humeral calli inconspicuously neutral grey pollinose and clothed on sides in front with pale orange-buff hair, postalar calli fringed posteriorly below with orange-buff hair; pleurae on each side with a thick tuft of orange-buff hair below humeral callus, and more posteriorly with two further tufts of similar hair arranged somewhat in the shape of a wide V, of which the anterior branch fringes the hind margin of the mesopleura, while the posterior runs back to the squamae; pleurae except as stated, and pectus except in front of front coxae clothed with black hair, pectus in front of front coxae neutral grey pollinose, clothed with pale orange-buff

hair. *Abdomen*: first six (visible) tergites in both sexes each with its lateral fourth on each side (rather more in case of ♀) clothed with close-set, appressed, minute, glistening smoke grey hairs (extreme lateral extremities of seventh tergite in ♀ clothed with hairs of same kind), so that dorsum of abdomen exhibits on each side a broad grey stripe, which in certain aspects contrasts fairly sharply with remainder of surface, which is clothed with minute appressed black hairs and thus forms a broad, longitudinal, median, black stripe; first (visible) tergite clothed with greyish pollen on each side at base, second tergite in both sexes on each side with a roughly semicircular whitish pollinose spot on hind margin, from most points of view concealed by the smoke-grey hair, but clearly visible when abdomen is looked at obliquely from behind, in ♀ a pair of similar but smaller whitish pollinose spots on hind margin of each of the two following tergites also; venter clothed with minute, appressed, glistening, smoke-grey hair, last two sternites, and sometimes median area of hind border of preceding sternite also, clothed mainly or entirely with black hair. *Wings*: extreme base of costa and first longitudinal vein brownish black; ochraceous orange base extending into bases of basal and anal cells, similarly coloured anterior border including upper margin of first basal and proximal fourth of first submarginal cell, thence tapering obliquely to end of third costal cell; veins within ochraceous orange area similarly coloured, elsewhere dark brown. *Squamae* light orange yellow. *Halteres*: stalks and knobs mummy-brown above and below, tips of knobs cream-buff. *Legs* black and clothed with black hair, front coxae anteriorly dark neutral grey pollinose, thinly clothed towards base with longish pale orange-buff hair.

Tanganyika Territory (formerly German East Africa): Itigi, iv, 1917 (*Dr. G. D. H. Carpenter*). Type of ♂, type of ♀, and 2 ♀ para-types, taken 18.iv.1917; 7 ♂ para-types, taken 15.iv.1917, "on composite flower"; 1 ♂ para-type, taken 6.iv.1917, "among low herbage." All foregoing presented by Imperial Bureau of Entomology, which retains possession of six additional para-types, taken by Dr. Carpenter at same time and place as specimens already enumerated.

The extremely striking and unusual-looking Tabanid just described belongs to the group of the genus *Pangonia* that includes *P. elongata*, Ric., *P. beckeri*, Bezzi, and *P. discors*, Austen, but is readily distinguishable from all three species by, apart from its sharply defined wing-markings and other characters, its unbanded abdomen and the patches of orange-buff hair on the pleurae. The coloration of the wings, in conjunction with the shining black body, would seem to suggest that *P. lautissima* possibly mimics some species of wasp (perhaps *Rhynchium cyanopterum*, Sauss.), and it is worthy of note that the same colours, though differing widely in extent and arrangement in the case of the wings, are exhibited by "*Pangonia*" *mesembrinoides*, Surc., of which the type was also obtained in Tanganyika Territory (Amani). The latter species, however, was incorrectly assigned by its describer to the genus *Pangonia*, and really belongs to a new genus allied to *Thriambeutes*, Grünb.

Pangonia carpenteri, sp. n.

♀.—Length (8 specimens) 15 to 16·6 mm.; width of head 4·25 to just under 5 mm.; width of front at vertex 0·6 mm.; distance from upper margin of occiput to anterior extremity of face 3·5 to 4 mm.; length of proboscis 11·75 to 13·75 mm.; length of wing 13·5 to 15 mm.

In ♀ sex, at any rate, a somewhat sombre-coloured species looking more like a small or medium-sized Corizoneura *than a* Pangonia, *and not unlike a smaller and more dusky form of* Corizoneura hastata, *Austen, of Portuguese E. Africa.—Face moderately produced; dorsum of thorax olivaceous black, with a pair of broad, paler (greyish olive), narrowly separated or sometimes confluent, admedian, longitudinal stripes; dorsum of abdomen shining blackish brown, on each side of base rather more than lateral third of first (visible) tergite ochraceous tawny, a similar area on each side of second tergite, or of second and third tergites, usually russet or chestnut-brown, lateral borders, posterior angles, and (at least in part) hind borders of second and fourth tergites clothed with glistening silvery white hair; wings strongly tinged with sepia; legs for most part ochraceous tawny.*

Head: ocelli wanting; face and front clothed with yellowish grey or isabella-coloured pollen, and front thinly covered with yellowish hair, lower half of front, above antennal prominence, with an ill-defined, shining black, median longitudinal mark, upper half of front usually streaked with mummy-brown or dark brown along each side, while a narrow mummy-brown streak, which starts from base of antenna on each side, runs obliquely upwards and outwards, and joins corresponding eye just above base of antennal prominence; below antennae, a shining black transverse band unites and includes the shining black facial calli; jowls and basi-occipital region clothed with long, whitish hair; occiput greyish olive or smoke-grey pollinose, sparsely clothed with cream-coloured hair, which also forms a short fringe behind posterior orbits above, lower portion of posterior orbits fringed with whitish hair; *palpi* elongate, proximal joint russet-brown or deep mouse-grey, sparsely clothed with whitish hair on outer side and below, terminal joint russet, somewhat expanded in middle, clothed with minute black hairs; first and second joints of *antennae* pinkish cinnamon or cinnamon-buff pollinose, both sometimes clothed with black hair though in some specimens hair on first joint is for most part yellowish, second joint usually with outstanding black hair above and below, third joint orange-cinnamon. *Thorax*: admedian stripes on dorsum entire, extending from front margin to prescutellar groove, outer border of each stripe paler in front of transverse suture; dorsum including scutellum thickly clothed with fine yellowish hair, with which in some specimens on central part of posterior portion of scutum a few fine black or blackish hairs are intermixed; postalar calli and lateral margins of dorsum behind transverse suture fringed with whitish hair, pleurae and pectus thickly clothed with similar hair. *Abdomen*: central portion of base of first (visible) tergite olivaceous black, basal angles of same tergite more or less distinctly neutral grey or dark neutral grey; rather less than median third of second tergite and a broad median triangle on each of following tergites, in each case with its base resting on hind margin and its apex in contact with front margin, and on fourth and following tergites with its base expanded laterally so as to include entire hind border of segment, dull dark olive-grey; olive-grey median area on second tergite (sometimes that on third tergite also) indented on each side; second tergite at base with a median, semicircular, dead black spot, or in some cases with a pair of smaller spots, narrowly separated in middle line by a dark olive-grey longitudinal stripe; first (visible) tergite with a median patch of glistening yellowish or pale yellowish hair, and clothed elsewhere with ochraceous hair; second tergite, except on black spot

(or spots) on which hair is usually black or ochreous, clothed with minute, appressed, glistening silvery white hairs, which however, at least on each side of median olive-grey area, are often largely replaced by similar ochreous hairs; lateral borders of fourth and following tergites, as well as (at least in part) hind border of fourth tergite, clothed with glistening, silvery white hair, similar hair also usually visible on lateral margins of third tergite, towards posterior angles; dorsum except as stated clothed with appressed black hair; venter isabella-coloured or light brownish olive, clothed with minute, appressed, whitish or yellowish white hairs. *Wings*: veins mummy-brown; first posterior cell variable as usual as regards distance from hind margin at which it is closed, sometimes closed on margin itself, or even in one or other wing narrowly open. *Squamae* cream-buff. *Halteres*: knobs fuscous, stalks cinnamon-buff. *Legs*: coxae neutral grey, clothed with whitish hair, anterior and inferior surfaces of femora clothed, at least in part, with black hair, femora elsewhere clothed with yellowish hair, tibiae and tarsi clothed with minute, appressed, ochreous hairs, extensor surfaces of hind tibiae and hind tarsi clothed, at least in part, with black hair; front femora blackish brown at base and sometimes also on greater part of under side, joints of front tarsi often mummy-brown or dark brown at tips above, those of hind tarsi similarly marked, or sometimes entire upper surface of hind tarsi, except base of first joint, dark brown.

Tanganyika Territory: Itigi, iv, 1917 (*Dr. G. D. H. Carpenter*). Type and 3 para-types, taken 18.iv.1917; 1 para-type, taken 15, iv, 1917, "on low herbage"; 1 para-type, taken 6.iv.1917, "hovering while feeding from composite flower; looking much like a *Bombylius*." All foregoing presented by Imperial Bureau of Entomology, in whose possession are two other para-types, taken by Dr. Carpenter at same time and place as specimens already mentioned.

So far as it is possible to judge from the ♀ alone, this species, which is named in honour of its discoverer and does not resemble any African *Pangonia* hitherto described, presents, apart from the venation, all the characteristics of a *Corizoneura*, to which genus it would have been assigned were it not that its posterior cell seems normally to be closed before reaching the wing-margin. Should the ♂ prove to have processes at the tips of the first and second joints of the front tarsi, *Pangonia carpenteri*, despite the transitional character of its venation, would more fittingly be placed under *Corizoneura*, so long as the independence of the latter be maintained.

Genus **Thriambeutes**, Grünb.

Thriambeutes fuscus, sp. n.

♂.—Length (1 specimen) 11·14 mm.; width of head 4·25 mm.; length of wing 10·5 mm.

Dorsum of thorax sepia-coloured, with traces of a faintly marked, paler, longitudinal median stripe in front of transverse suture, pleurae and pectus mummy-brown; abdomen uniformly blackish brown; wings mummy-brown, with a clear oblique transverse streak, commencing on anterior transverse vein (its base extending from commencement of lower border of distal fourth of first basal cell to proximal extremity of first posterior cell), including rather more than proximal third of discal cell, proximal extremity of fourth posterior cell, distal extremity of second basal cell, and upper border of proximal two-thirds of fifth posterior cell, but not reaching hind margin; legs blackish brown or black, middle tarsi cream-buff, last joint and tips of preceding joints cinnamon-brown.

Head black or blackish brown, occiput dark neutral grey pollinose, basi-occipital region thinly clothed with fine blackish brown hair; ocelli present, enlarged facets of eyes very coarse, area occupied thereby same as in ♂ of genotype (*Thriambeutes singularis*, Grünb., of Togoland and S. Nigeria), *i.e.*, small facets confined to a deep lower border and a narrower hind border of uniform width running up to ocelli; *palpi* blackish brown and clothed with fine hair of same colour, terminal joint elongate and curved but not conspicuously swollen, considerably smaller and narrower than in ♂ of genotype; antennal protuberance large and prominent, considerably larger and more prominent than in ♂ of genotype; first joint of *antennae* blackish brown, short, swollen, cylindrical, and clothed like second joint with blackish brown hair, second and third joints sepia-coloured, expanded portion of third joint rather broad. *Thorax* and *abdomen* thinly clothed with fine blackish brown hair. *Wings*: anal angle and lower region of distal extremity short of actual tip paler than elsewhere with exception of clear, transverse streak, a close scrutiny, when wing is viewed against a light back-ground, revealing beyond clear streak an ill-defined transverse band, which appears somewhat darker than remainder of surface; *stigma* well developed, elongate, cinnamon-brown when seen against a light background. *Squamae* blackish brown. *Halteres*: knobs ivory yellow, stalks sepia-coloured. *Legs*: coxae, femora and tibiae clothed with blackish brown or blackish hair, middle as well as front tibiae swollen (front and hind tarsi, and hind tibiae missing in case of type).

South Africa, Bechuanaland Protectorate: N'Gami Country, 1897 (*Sir Frederick Lugard, G.C.M.G., C.B., D.S.O.*).

The species characterised above is readily distinguishable by its wing-markings alone, apart from all other characters, from *Thriambeutes singularis*, Grünb. (the only other member of its genus as yet described), in which moreover the body as well as the head and its appendages are in the ♂ uniformly tawny.

So far as it is possible to judge from a photograph, which is all that is at present available for comparison, what appears to be another ♂ of *Thriambeutes fuscus* is in the possession of Mr. R. W. Jack, Government Entomologist, Southern Rhodesia, and was taken by him in November 1914, in Sebungwe District, Southern Rhodesia, on the jacket of a companion. In Mr. Jack's specimen, however, the clear streak in the wing reaches the hind margin, while the margin of the anal angle, and a further portion of the hind border embracing part of the distal extremity of the second submarginal cell and the distal extremities of the first three posterior cells are also hyaline.

APHIDIDAE OF PERSIA.

By F. V. Theobald.

Aphis buxtoni, sp. nov. (fig. 1).

Alate viviparous female.

Head and thorax dark; abdomen pale, apparently pale green, with dark lateral spots. Antennae, cauda and cornicles dark. Legs with mid and hind femora dark, front pair paler; apices of tibiae and the tarsi dark. Antennae shorter than body, rather thick; basal segment larger and paler than second; third much longer than fourth and about as long as the sixth, with 18–20 small round pale sensoria over its whole length; fourth segment very slightly longer than fifth, with 5–8 sensoria; fifth with 4–7 sensoria of unequal size, exclusive of the usual subapical one; sixth with the rather thick basal area less than one-third the length of flagellum, in some however almost half its length; all the segments from the third imbricated. Eyes

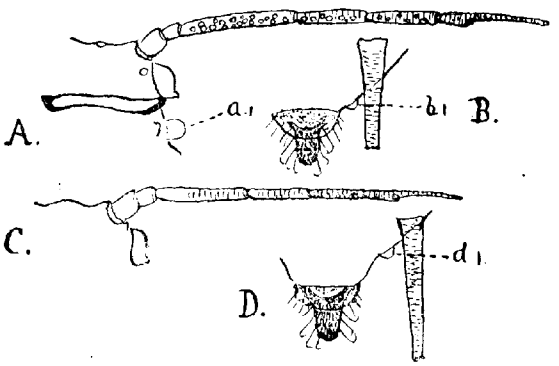

Fig. 1. *Aphis buxtoni*, sp. n.: A, B, alate ♀; a_1, lateral bladder-like papilla; b_1, lateral papilla; C, D, apterous ♀; d_1, lateral papilla.

large. Proboscis reaching to the third coxae. A large pale bladder-like papilla on each side of pronotum and five pairs of pale rounded papillae on sides of abdomen. Cornicles about as long and as thick as third antennal segment, cylindrical, markedly imbricated, not reaching to the level of the cauda. Cauda bluntly pointed, about half the length of the cornicles, spinose; with numerous fine hairs, curved apically. Anal plate spinose, with fine pale hairs. Tibiae with numerous fine, pale, short hairs. Wings with normal venation; veins and stigma brown, the veins very faintly and narrowly clouded on each side. *Length*, 2–2·2 mm.

Apterous viviparous female.

Pallid, with dark head, cornicles, cauda and anal plate, also dark antennae and mid and hind legs, the fore pair paler. Antennae shorter than body, rather thick; basal segment larger than second, both very dark; third paler at base, longer than fourth and about same length as sixth; fourth a little longer than fifth, the latter with the usual sub-apical sensorium; sixth with basal area nearly half the length of

flagellum; segments 3–6 imbricated. Eyes dark, of moderate size. Proboscis reaching to the second coxae. Cornicles cylindrical, longer than third antennal segment, imbricated. Cauda blunt and rather short, not half the length of the cornicles, spinose, with numerous pale hairs; broader than cornicles; the hairs curved apically. Anal plate spinose, with long pale hairs. The rather thick set legs have the coxae and trochanters darker than the rest of the legs; a few short hairs on the femora, many on the tibiae. *Length*, 2 to 2·5 mm.

Food-plant: Umbelliferae.

PERSIA: Enzeli, Caspian Coast, 6.vi.1919 (*P. A. Buxton*).

Types in the British Museum.

Described from a single perfect alate female and several apterae. One of the latter shows the cornicles not reaching the cauda, others passing it. It is a very marked species, the black cornicles, cauda, etc., showing up prominently against the pale body. The antennae are short, as in the genus *Cavariella* and the cauda is markedly spinose. I can see no trace in the mounted apterae of any lateral pronotal or abdominal papillae, as seen in the alate female. The larval stages are more uniform in colour, but in succeeding instars the blackness of the cornicles, etc., gradually becomes more pronounced.

This species was found in association with an ant that has been identified by Mr. W. C. Crawley as *Lasius emarginatus*, Latr., var. *nigro-emarginatus*, Forel.

Myzus mespiliella, sp. nov. (fig. 2).

Apterous viviparous female.

Green or yellowish green; antennae of same colour as body, dusky at apex of fifth segment, the sixth dusky, with a more or less darkened area at the junction of basal portion and flagellum. Eyes deep reddish-black. Proboscis of same colour as body, dark at apex. Legs same colour as body, apex of tibiae and tarsi dusky. Cornicles and cauda of same colour as body; in some the former seem a little darker. Anal plate darker than cauda.

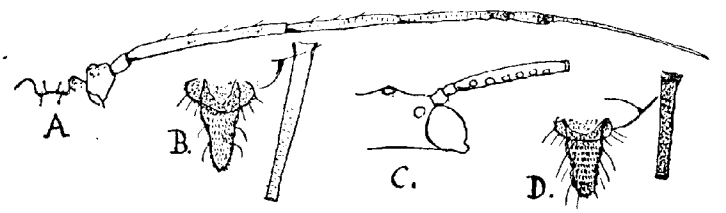

Fig. 2. *Myzus mespiliella*, sp. n.: A, B, apterous ♀; C, D, alate ♀.

Antennae longer than body; basal segment larger than second; third segment longer than fourth, but not quite so long as the sixth; fourth a little longer than fifth; the sixth about as long as 4 + 5, with moderately long flagellum; a few short hairs on third and fourth. Proboscis rather long, reaching to or just beyond the third coxae. Cornicles slightly longer than fourth antennal segment, cylindrical, slightly broadening at the base, markedly imbricated. Cauda reaching not quite to the level of the cornicles, less than half their length, narrowly triangulate or pointed, spinose, with two pairs of lateral hairs. Anal plate spinose, with several long hairs. Tibiae with numerous small hairs, becoming longer near apex. The

vertex shows two short and two longer slightly capitate hairs. A few short blunt lateral abdominal processes. *Length*, 1·5–1·8 mm.

Alate viviparous female.

Only imperfect specimens sent. Apparently dark and of reddish hue with dark head, thorax, cornicles and cauda; legs paler, with dark apices to tibiae and dark tarsi; two basal segments of antennae dark, third pale. The abdomen has dark lateral and dorsal spots and the proboscis is pale towards the tip, but extreme apex dark. The basal segment of antennae larger than second; the third with 6–7 large round sensoria in a line. Eyes large and deep reddish-black. The black cornicles are cylindrical, shorter, but a little thicker than third antennal segment, slightly expanding basally and not quite reaching the level of the cauda, markedly imbricated. Cauda black, more than half the length of the cornicles, more or less constricted near the middle, spinose, with long, fine hairs; blunt apically. Anal plate black, with long pale hairs. Wings large, venation normal. The abdomen shows four small dark blunt lateral processes before the cornicles and one between the cornicles and cauda. *Length*, 1·8–2 mm.

Food-plant: Medlar (*Mespilus*).

N. W. PERSIA: Enzeli, 29.iv.1919 (*P. A. Buxton*).

Types in the British Museum.

Described from several perfect apterous females, but both alatae damaged, neither showing complete antennae. The sensoria on the third segment are marked. The only other *Mespilus* species is Van der Goot's *Myzus mespili*, which is very distinct. The vertex and lobes of the apterae and the basal segment of the antennae approach to some extent those of the genus *Phorodon*, but in the alate stage it is a distinct *Myzus*. It was found on the young twigs of the medlars, not doing much harm. Ants were found in attendance.

Aphis punicae, Passerini (fig. 3).

A. punicae, Pass., Aphid. Italicae, pp. 32 et 42, n. 26 (1863).

Alate viviparous female.

Antennae shorter than body; two basal segments dark and a dark area at apex of fifth and around the sensoria on sixth, or all dark except base of third segment;

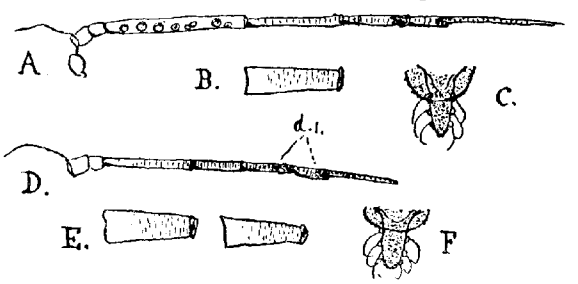

Fig. 3. *Aphis punicae*, Pass.: A, B, C, alate ♀; D, E, F, apterous ♀; d^1_1, dark areas on antennae.

basal segment wider but no longer than second; third nearly as long as the sixth, with 6–8 sensoria spread over its whole length, two frequently smaller than the others; fourth segment longer than fifth, the latter with the usual subapical sensorium; the sixth about as long as 4 + 5; fourth to sixth imbricated. Cornicles

dark, about as long as fourth antennal segment and thicker, cylindrical, imbricated, not reaching to the tip of cauda. Cauda pale, shorter than the cornicles, with three pairs of lateral hairs, curved apically and arising from prominent tubercles. Anal plate darker than cauda. Femora of mid and hind legs dark, except just at base; front pair paler; apices of tibiae and the tarsi dark. Wings normal. *Length*, 1–1·5 mm.

Apterous viviparous female.

Antennae shorter than body, pallid, except for a small dark area at apex of fifth segment and one around sensoria on sixth; basal segment wider but scarcely longer than second; third a little shorter than sixth, but longer than fourth; fourth and fifth about equal; sixth with flagellum about twice as long as basal area. Cornicles about as long as third antennal segment, broadening basally, pale, dark at apex, not reaching as far as cauda. Cauda pale, with three hairs on each side, curved at their tips and arising from marked tubercles; not quite as long as cornicles. Anal plate dark. Marked pronotal lateral tubercles and one each side of body before the hind legs. Apices of tibiae and the tarsi dark. Proboscis not reaching to third coxae. *Length*, 1–1·5 mm.

Food-plant: Wild Pomegranate.

N.W. Persia: Tula Road, Talish District, S.W. Coast of Caspian, 9. vii. and 5. viii. 1919 (*P. A. Buxton*). Italy (*Passerini* and *Theobald*).

Apparently the apterae only were described by Passerini. The alatae seem to vary in the colour of the antennae in the mounted specimens, some are pale with two dark areas, others all dark except the base of the third segment. The specimens taken by Mr. Buxton were on the twigs, attended by ants (*Cremastogaster scutellaris schmidti*, Mayr, and *Tapinoma erraticum nigerrimum*, Nyl.). Passerini records it from *Punica granatum* and *P. sylvestris*. The *Aphis punicellae* I described from Egypt on *P. granatum* (Bull. Ent. Res. vi, p. 125) is quite a distinct species.

Lachnus pyri, Buckton (fig. 4).

L. pyri, Buckt., Indian Museum Notes, iv, p. 271, pl. xvi (1899).

Taken on pears at Karmanshah, W. Persia (4. xii. 18) by Mr. P. A. Buxton.

This species was described by Buckton (with notes by E. E. Green) from pears in Ceylon. The Persian specimens agree with the Pear Lachnid I have from Ceylon and answer generally to Buckton's short description. I append some characters of the antennae, etc.

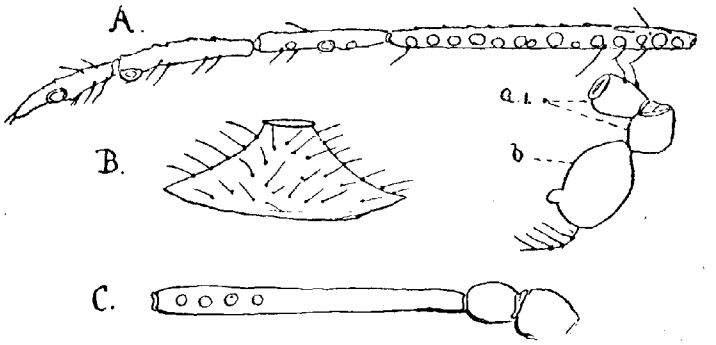

Fig. 4. *Lachnus pyri*, Buckt.: A, antenna of alate ♀; *a*, basal segments; *b*, eye; B, cornicle; C, 1st to 3rd antennal segments of apterous ♀.

Alate viviparous female.

Antennae of six segments; first two large and dark, third the longest, with 13–15 round sensoria of unequal size and a few hairs; fourth about as long as fifth, with 3 sensoria; fifth longer than sixth, with one large subapical sensorium; sixth with 'nail' shorter than basal area and a large sensorium at its base, a few moderately long hairs. Eyes large. Cornicles dark, of normal form, hairy.

Apterous viviparous female.

Basal segments of antennae large and dark; third segment with 3–4 uniform round sensoria situated near apex. Cornicles as in alate ♀. A marked median abdominal tubercle.

The specimens sent by Mr. Buxton were all very much damaged. Another Lachnid (*Nippolachnus piri*, Matsumura) occurs on *Pirus sinensis* in Japan, but is very distinct (*vide*, "A list of the Aphididae of Japan, with descriptions of New Species," Journal of the College of Agriculture, Tohoku Imperial University, vii. pt. 6, p. 382, July 1917).